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Forty-eight instructors and forty-one practitioners representing 12 occupations (dental assistant, dental laboratory technician, inhalation therapist, medical assistant, medical records technician, associate degree nurse, practical nurse, occupational therapist, physical therapist, X-ray technician, medical secretary, and medical laboratory assistant) rated 279 items of knowledge from the various sciences, psychology, and sociology as "not needed," "helpful," or "essential." Groups of basic knowledges from the fields of anatomy and physiology were judged "helpful" or "essential" by 60 percent or more of the respondents representing all the occupations. Respondents in all fields except medical records and occupational therapy indicated need for knowledge of microbiology. Respondents representing occupational therapy were the only ones who indicated no need of chemistry, while respondents from all occupations indicated need for some knowledge of physics. Only respondents in the laboratory field indicated that knowledge of psychology and sociology would not be useful. Respondents representing the field of medical records indicated a slight need for chemistry, physics, and microbiology knowledges and a greater need for familiarity with terminology associated with human anatomy and physiology. The hypothesis that certain cores of knowledge are commonly useful in the 12 occupations was supported. (JK)

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FINAL REPORT
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Willenstein
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KNOWLEDGES COMMONLY USEFUL IN TWELVE ALLIED HEALTH OCCUPATIONS

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Washington State Univ~~ersity,~~ Department of Education, Pullman, Washington
State Coordinating Council for Occupational Education, Olympia, Washington

CONTENTS

		Page
ACKNOWLEDGEMENTS		iii
LIST OF TABLES		iv
SUMMARY		1
Chapter		
I.	INTRODUCTION	3
	The Need for the Study	4
	The Problem	5
	Purpose of the Study	5
	Definitions of Terms	6
	Delimitations	7
II.	REVIEW OF THE LITERATURE	8
	Expressions of Concern	8
	Related Research	15
III.	METHODOLOGY	21
	The Population	21
	Development of Data-Gathering Instrument	22
	Method Used in Distribution of the Data-Gathering Instrument	23
IV.	RESULTS AND FINDINGS	26
V.	ANALYSIS, CONCLUSIONS, AND RECOMMENDATIONS	70
	Analysis	70
	Conclusions	74
	Recommendations	75
BIBLIOGRAPHY		76
APPENDIX		
A.	QUESTIONNAIRE	85
B.	KNOWLEDGE ITEMS DELETED FROM ORIGINAL QUESTIONNAIRE BECAUSE PILOT TESTING INDICATED USEFULNESS IN ONLY ONE OR TWO OCCUPATIONS	96

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LIST OF TABLES

Table		page
1.	Occupational Representation of Respondents	24
2.	Percentages of All Responses Regarding Usefulness of Knowledge Items	27
3.	Percentage Rank Order of Items Judged "Essential" and of Items Judged Either "Helpful" or "Essential"	40
4.	Knowledges Judged "Helpful" or "Essential" by Sixty Per Cent or More of Respondents in Each Occupation	56

SUMMARY

Purpose

A growing number of the nation's community colleges are developing allied health occupations training programs. The purpose of this study was to ascertain the extent to which there exist commonalities of knowledges essential for effective work in twelve allied health occupations. It is assumed that identification of such commonalities can provide a partial base for curriculum planning and for evaluating technician training programs.

Population

Forty-eight instructors and 41 practitioners used the questionnaire to rate each of the 279 knowledge items as "not needed" "helpful".

Responses were arranged in rank order. This provides measures of degrees to which various categories of workers deemed specific knowledges and clusters of knowledges useful.

Procedure

By consultation with instructors, practitioners and supervisors, the author constructed and field tested a check list of 279 knowledge items from the disciplines of anatomy, physiology, microbiology, chemistry, physics, psychology and sociology deemed useful for work in the following twelve allied health occupations: dental assistant, dental technician, occupational therapy assistant, physical therapy assistant, medical assistant, medical records technician, cardio-pulmonary technologist, registered nurse, x-ray technician, medical secretary and medical laboratory technician.

Results

Groups of basic knowledges from the fields of anatomy and physiology were judged to be useful for efficient work by 60 per cent or more of the respondents representing all twelve of the occupations. Tables 2, 3, and 4 show details.

All respondents except medical record technicians and occupational therapy assistants indicated need for knowledge of microbiology. Occupational therapists were the only group to indicate no need for knowledge of chemistry. Respondents from all occupations indicated need for some knowledge of physics. Only the laboratory assistants indicated that knowledge of psychology and sociology would not be useful for efficient work.

The nature of work performed by medical record technicians is primarily clerical. As might be expected, these workers indicated slight need for chemistry, physics, or microbiology knowledges. Apparently, the primary need of this group of workers is for familiarity with terminology associated with human anatomy and physicology. (See Chapter V for details)

Curriculum Implications

Results of the study suggest that for preparation of allied health occupations workers, much instruction in anatomy, physiology, microbiology, chemistry and physics might be usefully organized into a basic interdisciplinary core. Such use of science faculties would free nurses, inhalation therapists, medical laboratory technicians, and the like, for practical instruction in their respective fields of applied science.

CHAPTER I

INTRODUCTION

The chronic short supply of workers in the health occupations is approaching a critical level due to an increasing demand for quality health services. President Lyndon B. Johnson, in a letter to the Secretary of Labor, pointed out, "Our examination of the nation's health problem makes clear that the most critical need is in the manpower field."[1] Other agencies, public and private, have expressed the same concern for qualified workers in health occupations.

William L. Kissick[2] reported to the Institute of Policy Studies on February 22, 1966, the results of a study conducted by the American Hospital Association and the United States Public Health Service which indicated 1.4 million professional, technical, and auxiliary personnel were then employed in the 7,100 hospitals registered with the American Hospital Association. The report estimated that at that time an additional 275,000 employees were needed to provide optimum patient care.

The Washington State Department of Employment Security[3] published the results of a statewide study (exclusive of Spokane County) which predicted that in 1966 the state would require 31,610 workers in health occupations, 37,740 in 1968, and 42,650 in 1971. The training capacity of all institutions in Washington currently involved in producing the skilled manpower required for the health occupations cannot cope with this demand. More efficient training procedures will have to be devised.

The rapid advances in biomedical knowledge, a growing social concern for extending quality medical services to all Americans, and the increasing life span, all point up the need

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[1]Lyndon B. Johnson, "Letter to Secretary of Labor, September 29, 1966," Employment Service Review, 3 (November, 1966), 2.

[2]William L. Kissick, "Health Manpower in Transition," (unpublished manuscript presented at the Institute for Policy Studies, Washington, D.C., February 22, 1966, pp. 1-55).

[3]Washington State Employment Security Department, Occupational Manpower Projections, 1966--1968--1971 (Olympia: State of Washington, 1967).

for enlargement of training programs to more efficiently train workers for the health occupations.

The Need for the Study

Public and private health agencies express concern about the continuing insufficient supply of adequately trained workers for the allied health professions. Two phenomena of major proportions have begun to have an increasing effect on the quality and quantity of personnel for the health services. One factor is the tendency toward more specialization; the other is the trend toward institutionalization of medical service. Both of these trends are accelerated by advances in biomedical science and the application of technology to medical practice.

Prior to World War II there was only a slight tendency for physicians to specialize rather than become general practitioners. Nine out of ten of today's medical school graduates go into specialized fields. Therefore, many of the health functions formerly carried on by the physician must now be diversified and accomplished by other less highly trained workers in the health service.

Completely new health occupations have evolved since 1945. For example, the career fields of inhalation therapy, nuclear medical technician, radiological health technician, cytological technician, and medical engineering technician did not exist prior to World War II. To provide the highest possible quality of medical service will depend upon developing well equipped medical institutions in which highly sophisticated medical teams will function.

One of the apparent reasons for the continued shortage of skilled health workers is due to the inefficient educational system that has evolved for the training of individuals for the health occupations. William L. Kissick points up the issue by saying:

> For the most part, a recruit to the health endeavor is expected to select his or her ultimate goal and then enter a highly structured--"lock step"--curriculum that presents first general and then specific information. Once graduated, the individual is supposedly prepared to perform certain functions for the ensuing decades.[4]

"Approaching health manpower as an interrelated whole rather than merely an agglomeration of disparate categories of personnel is essential."[5]

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[4]Kissick, p. 27.

[5]*Ibid.*, p. 43.

The Problem

This study is based on the general hypothesis that certain cores of knowledge are commonly useful in many paramedical occupations. Assuming that such commonality of usefulness of knowledge does exist, the intent of this investigation is to determine its extent.

Fundamentally, medicine is the application of the biological, physical, and social sciences to alleviate man's discomfort. It follows, therefore, that the search for commonality of knowledges should begin with the basic sciences that make up the foundation of medicine and its allied health occupations. Many authors have commented on the obviously wasteful practice of giving separate lectures in basic human anatomy and physiology for medical, dental, and nursing students. A similar practice is also followed in such subjects as microbiology, chemistry, and psychology. The focus of this research, then, was upon the subject matter areas of human anatomy and physiology, chemistry, microbiology, physics, sociology, and psychology to determine if there are elements of commonality of knowledges that are required by all, or most of the allied health professions. Particular attention was paid to the determination of those knowledges that are normally taught in the elementary courses as it appears that it is at this level where much of the duplication of effort takes place.

Purpose of the Study

The purpose of this study was to ascertain the extent to which there exists a commonality of knowledges essential for effective work in twelve allied health occupations.

This study was a first step in identification of knowledges required by workers in allied health occupations. It was intended to provide a partial base for the future development of more efficient training programs, and the eventual provision for upward mobility of health occupations workers.

It is hoped that determination of the commonality of need for knowledges from the basic sciences will provide educators with a basis for evaluating training programs and for devising ways to teach such subject matter more efficiently. It is also hoped that facts about degrees to which cores of knowledge are commonly useful will also provide a basis for development of integrated basic science courses designed for preparation of those in the health fields rather than having students in the allied health occupations taking courses designed for students of general studies.

In addition, it is hoped that knowing that a commonality of required knowledges may not exist in certain fields would allow for the elimination of unrelated subject matter from specific programs.

Demonstration of the common usefulness of knowledges may also stimulate the development of "core" curricula for the allied health fields. This can contribute to the efficiency and flexibility of training programs.

Definitions of Terms

Paramedical occupations are those in which owrkers need some amounts of specialized training in applied biomedical sciences, less than those required for baccalaureate degree.

Allied health occupations are synonomous with paramedical occupations.

Health professions are medicine, dentistry, and nursing with at least the baccalaureate degree required.

Allied health professions means all health workers who are trained at least to the baccalaureate degree level except for medicine, dentistry, and nursing.

Panel of experts included the Spokane Community College instructors in the health occupations of practical nursing, medical records technology, inhalation therapy, dental assisting, medical secretary, and cardio-pulmonary technology, who critically reviewed the preliminary check list of knowledges.

Allied health occupations practitioners are the selected individuals who were currently employed in the health occupation for which they were trained, and who responded to the final form of the knowledges check list.

Allied health occupations professionals are the selected instructors in the various health occupations who responded to the check list.

The term "knowledge" as used in this study was defined as Benjamin S. Bloom and associates stated, "Knowledge, as defined here, involves the recall of specifics and universal, the recall of methods and processes, or the recall of a pattern, structure, or setting."[6] Knowledge levels used included those of specifics,

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[6]Benjamin S. Bloom (ed.), Taxonomy of Educational Objectives, Handbook I, The Cognitive Domain (New York: David McKay Co., 1956), p. 201.

terminology, specific facts, way and means of dealing with specifics, conventions, trends, classification, criteria, methodology, universals, and abstractions, principles, generalizations, and theories.

Delimitations

The paramedical occupations included in this study were those whose training period is at least one, but less than four, academic years in length.

The occupations included in this study were limited to those for which training programs are currently being conducted by community colleges in the State of Washington.

The findings derived from the data produced from the questionnaire are limited to the accuracy of the responses.

CHAPTER II

REVIEW OF THE LITERATURE

There exists a paucity of literature related directly to the field of commonality of knowledges in the paramedical occupations. The following reports of investigations are included only because they indicate a tendency toward this type of study, and an indication of methods used.

Expressions of Concern

Robert E. Kinsinger[1] outlined a concept of a "theory-skills spectrum" for all health occupations from the semiskilled nurse aide, or orderly, to the medical research scientist. Thus there would exist a continuum of knowledge and skills that could be assumed to start from a more or less common base point. For example, the semiskilled nurse aide would require only the most elementary knowledge of the applied sciences since her activity is restricted primarily to basic skills in working with and for people.

The "theory-skills spectrum" concept leads into yet another of the reasons for having conducted this investigation to determine commonality of knowledges required by the allied health professions. There is a need for establishing a career ladder which would permit and even encourage workers in the health occupations to move upward to more advanced levels of responsibility, thereby taking advantage of their study and experience at one level to advance themselves to successively higher levels within the limit of their ability. The development of curricular changes that could enhance the opportunity for upward mobility of workers in the health occupations would put a new forward thrust in the whole field of allied health professions.

It seems that two very beneficial effects would result from the evolution of a scheme for the development of a career ladder system. First of all, it should have a positive effect on the unusually high attrition rate that occurs in many of the allied health occupations and professions. Students in the allied health

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[1]Robert E. Kinsinger, Education for the Health Technicians--An Overview (Washington, D.C.: American Association of Junior Colleges, 1965), p. 2.

fields could change their minds, and their goals, without suffering the complete loss of credit for what they had accomplished such as now occurs when changes are made in "boxed-in" programs. In the words of William L. Kissick:

> The increasing rate at which scientific and technological advances are being achieved indicates the foolhardiness of considering any preparation as terminal. It has been suggested, and advocated, that the intimate relationship between educational and service programs[2] discussed above would enable education to become a truly continuous process.[3]

A second improvement to be derived from the career ladder concept would be the advantage that would obtain in recruiting students for the allied health professions. In this day of rapid change in biomedical and technological application many people are reluctant to become involved in what they consider to be "dead-end careers." It is much better, from the students point of view, to be able to enter a field at one level with the knowledge that he may aspire to higher levels of responsibility and remuneration.

In the report of the National Health Advisory Commission under the heading of Education of Health Professionals it is noted:

> Our own analyses have shown that the great increases in productivity of health professionals have resulted mainly from increased use of ancillary personnel . . . . The short lead-time for training these health workers permits rapid changes in output to meet expanding demand in contrast to the long training period of health professionals, which requires many years.[4]

It was the contention of John R. Hall[5] that to the employee the career ladder allows him to make the most of his talent and drive. He felt that the hospital administrator will find the

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[2]Service programs refer to the allied health fields.

[3]Kissick, "Health Manpower in Transition," p. 46.

[4]Report of the National Advisory Commission of Health Manpower, Vol. 1 (Washington, D.C.: Government Printing Office, 1967), p. 23.

[5]John R. Hall, "Toward Health Career Ladders," Employment Service Review, 3 (November, 1966), 23.

career ladder a helpful device for recruiting the help he needs. Realistically, though, he said, "The medical organization, into which the career ladder must be introduced, has long been noted for the glacial rigidity of its personnel structure."[6]

The National Advisory Health Council's Allied Health Professions Educational Subcommittee was also concerned about the upward mobility of students. "To assure opportunities for upward mobility of students trained initially at lower levels, colleges of allied health professions should also be intimately related to technical training centers, probably the most significant of which, in the future, will be those in junior colleges."[7]

The Western Council of Higher Education in Nursing[8] reported that while the associate degree nursing programs were established with a primary terminal intent, a trend is developing for the granting of credit toward the baccalaureate degree through challenge by examination. Baccalaureate nursing programs responding to the study indicated acceptance of credit toward the degree varying from 26 to 72 semester hours in nursing. This, then, could account for about 50 per cent of the professional nursing credits required for the baccalaureate degree.

A logical outgrowth from the concern thus far expressed for the need to provide for the upward mobility of health occupation workers, and the concept of the "theory-skills spectrum" would be the advocation of a core curriculum for the allied health professions. The Allied Health Professions Educational Subcommittee made note of this aspect when they referred to the one and two-year programs in the allied health fields that were being conducted by vocational-technical schools and community colleges as follows:

> In the past most of these programs have been operated as independent entities, with little or no interrelationship. Yet increasingly, a common core is being identified that makes possible the sharing of instructors, classes, facilities, library, clinical resources, and

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[6] Ibid.

[7] The National Advisory Health Council, Allied Health Professions Educational Subcommittee, Education for the Allied Health Professions and Services, Public Health Service Publication Number 1600 (Washington, D.C.: Government Printing Office, 1967), p. 25.

[8] Western Council of Higher Education in Nursing, Today and Tomorrow in Western Nursing (Boulder, Colorado: Western Council of Nursing, April, 1966), pp. 28-29.

> other educational services, and centers for interdisciplinary education are being developed. These are proving more effective in producing the kinds and quality of workers needed for the variety of occupations in the health field.[9]

In the same report it was pointed out that:

> Attention to the core curriculum and equivalency of training is vital to both the professional and technical curriculum . . . . While it is desirable to have certain courses in a junior college accepted for credit in a senior college, it is perhaps more important to adopt the principle of credit for attainment in a field which could be tested by examination.[10]

We see that the career ladder idea, the concept of the "theory-skills spectrum," and the core curriculum proposal are all interrelated.

John L. Caughey wrote, "As medical care gets more complex, division of labor grows increasingly prominent. In turn, this development raises questions of the relation of newer technical personnel to the older professions."[11] In the same discussion, but more directly referring to medical technologists, Caughey stated, "One of the characteristics of medical technology is that it is subject to unlimited superspecialization."[12] The same may be said of virutally all of the allied health professions. All concerned with training health occupation workers must strive to obtain an understanding and an appreciation for the professional relationship that must exist with the patient through careful coordination and integration of the comprehensive health services.

An analysis of President Johnson's "Message on Children and Youth" by B. Nelson[13] emphasized the need for reviewing the

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[9]The National Advisory Health Council, Allied Health Professions Educational Subcommittee, pp. 19-20.

[10]Ibid., p. 23.

[11]John L. Caughey, "Auxiliary Personnel in Medical Practice," American Journal of Public Health, 48 (August, 1958), 1049.

[12]Ibid.

[13]B. Nelson, "L. B. J.'s Message on Youth: Pointing a New Path for Medical Practice," Science, 155 (February 17, 1967), 811-812.

training methods currently used in preparing health manpower. In order to do something about the persistent criticism of American medical practice contending that its manpower resources are inefficiently deployed and utlized, the establishment of ten pilot centers was called for to develop more efficient methods and techniques for health care delivery, and to train new types of health workers.

In 1961 Denza Sheehan[14] reported that a total of 50,374 histological technicians were needed to work with medical technologists in more than 9,000 laboratories. At that time, a two-year training program for histological technicians was being conducted in the laboratory of the University Hospital, University of Pennsylvania.

William Mirengoff wrote that, "The health services have grown to be one of the largest sources of employment in our national economy."[15] In 1966, of about 3.5 million in health occupations, only about one million were doctors, dentists, and nurses.

In the same report Mirengoff pointed out that:

> Perhaps the most dynamic structural factor in the next decade will be a massive growth in the number and capacity of nursing homes. By 1975 the number of nursing home beds is expected to more than double, with employment far exceeding the current level of 250,000.[16]

A factor associated with this prospect is that most of the workers required by nursing homes will be at the lower levels of the career ladder.

Another interesting point made by Mirengoff[17] was that because two-thirds of all health workers are women, special attention must be given to meeting their needs for flexible and part-time work schedules.

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[14] Denza Sheehan, "Need for Training Program for Histology Technicians," American Journal of Medical Technology, 27 (September-October, 1961), 280-286.

[15] William Mirengoff, "Health Manpower--An Emerging Challenge," Employment Service Review, 3 (November, 1966), 4.

[16] Ibid., p. 7.

[17] Ibid., p. 10.

Eleanor C. Lambertsen[18] in a series of articles indicated the changing role of the professional nurse as that of being responsible for supervision of nursing care as well as direct patient care which requires professional knowledge, judgment, and skill. She feels that technicians will have to be trained to utilize the technical devices.

Brita Asplund[19] was also concerned about the changing role of the nurse which historically was based on patient's need, care, and support, but is now gradually shifting toward more responsibility for diagnosis and therapy.

According to Frances Ginsberg[20] functions of an operating room nurse are purely technical and can be accomplished by a skilled technician instead of a nurse. Ginsberg wrote a series of articles concerned with the development of training programs for training operating room technicians including criteria for selection of potential trainees and the description of an experimental program carried on at Tufts-New England Medical Center in Boston.

Gerald J. Griffin and Robert E. Kinsinger[21] reported on an experimental method for increasing the effectiveness of teaching

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[18]Eleanor C. Lambertsen, "Nurses Have Been Trained to Nurse People, Not Machines," Modern Hospital, 105 (October, 1965), 146; _____, "Staffing Problems Emphasize Need for Better Supervision by R.N.'s," Modern Hospital, 106 (March, 1966), 146; _____, "Does the Doctor's View of Nurses Require Redefinition of Nursing?" Modern Hospital, 107 (October, 1966), 144.

[19]Brita Asplund, "The Nurses Role Tomorrow," International Nursing Review, 13 (December, 1966), 25-33.

[20]Frances Ginsberg, R. N., "Hospitals Face Crisis in O.R. Nursing Unless Attitudes Change," Modern Hospital, 106 (March, 1966), 142-143; _____, "How to Select Candidates for Surgical Technical Aide," Modern Hospital, 107 (July, 1966), 114; _____, "What to Include in Surgical Technical Aide Training Plan," Modern Hospital, 107 (August, 1966), 126.

[21]Gerald Joseph Griffin, Robert E. Kinsinger, and Avis J. Pittman, Clinical Nursing Instruction by Television: A Report on a Two-Year Experiment Using Closed-Circuit Television to Teach Clinical Nursing (New York: Teachers College, Columbia University, 1965), pp. 1-35; Robert E. Kinsinger, "Stretching Instructional Talent," Junior College Journal, 35 (October, 1964), 22-25.

clinical nursing by utilizing closed circuit television and individualized radio receivers.

Milton E. Howard[22] and Edward C. Stannard[23] individually reported on an experimental situation which provided on-the-job training experience for medical secretaries. The project was considered successful even though the medical clinic was 22 miles away from the training center.

R. H. Berg[24] described an experimental program which trained navy corpsmen to become physicians assistants. The purpose of the project was to extend the effectiveness of the highly trained physicians by giving selected corpsmen an intensive two-year on-the-job training program.

Robert W. Coon and Dallas Johnson[25] contended that the causeway for carrying the fruits of scientific research and invention to the clinician and patient is the medical laboratory. They report that laboratory work loads are up over 50 per cent in spite of automation, recruiting, and retraining. According to these men, the current need is for 100,000 laboratory workers, and by 1971 the need will reach 130,000 while all of the training facilities turn out about 4,000 medical laboratory workers per year. This includes pathologists, medical technologists, and certified medical laboratory assistants.

A. I. Hudes[26] reported on an experimental high school program in medical technology which was open only to seniors who had a year of chemistry and biology. The program was very introductory in nature, as it was aimed at giving the student an exploratory vehicle to determine if he wanted to pursue a career in the healing arts. A cooperative on-the-job phase was included.

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[22]Milton E. Howard, "Medical Secretary--Secretary, Technician, Both?" Junior College Journal, 35 (February, 1965), 15-17.

[23]Edward C. Stannard, "On-the-Job Training for Medical Secretaries," Junior College Journal, 35 (February, 1965), 17.

[24]R. H. Berg, "More Than a Nurse, Less Than a Doctor: Ex-medical Corpsmen as Physicians Assistants at Duke University School of Medicine," Look, 30 (September 6, 1966), 58-61.

[25]Robert W. Coon and Dallas Johnson, "Laboratory Manpower Need Outruns Supply," Modern Hospital, 107 (November, 1966), 133.

[26]A. I. Hudes, "Experimental Course in Laboratory Technology," Science Teacher, 33 (May, 1966), 45.

S. M. Eisler[27] reported on similar high school programs of medical technology which consisted of six units including an introduction to medical technology, hematology, urinalysis, blood chemistry, histology, and microbiology. This program was also only introductory in nature. The intent was that students would complete their training for medical laboratory assistants by on-the-job training.

The National Commission on Community Health Services[28] suggested the development of a new type allied health employee, the "expediter", who will provide the human link between the patient and the comprehensive health services.

In the same report the Health Commission[29] admonished two-year colleges to expand programs as rapidly as is consistent with quality; to design programs that include the opportunity for additional education at a later time; and to affiliate with four-year colleges and medical institutions for laboratory experience, clinical experience, and consulting services. They also recommend the development of state and regional agencies for planning two-year programs.

Related Research

A study of the duties, knowledges, and skills required of selected medical record librarians to determine curricular content of baccalaureate degree programs was conducted by Frank Kendrick Bangs.[30] The procedure followed included these steps:

1. Activity analysis blanks were completed by librarians.

2. Duties of medical record librarians were collected by questionnaire and sent to the hospital administrators of the hospitals which employed the librarians included in the study.

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[27]S. M. Eisler, "Medical Technology: A New Course for the Inner City High School," Science Teacher, 32 (March, 1965), 33-34.

[28]"Health is a Community Affair," Report of the National Commission on Community Health Services (Cambridge: Harvard University Press, 1966), pp. 77-215.

[29]Ibid.

[30]Frank Kendrick Bangs, "Duties, Knowledges, and Skills Required of Medical Record Librarians" (unpublished Ph.D. dissertation, School of Education, Indiana University, Bloomington, Indiana, 1952), pp. 1-161.

3. Skills and knowledges were determined by analysis of the duties and responsibilities survey, and then classified into areas of learning.

4. Appropriate levels for teaching the skills and knowledges were designated.

5. A jury of medical record librarians reviewed the level placement.

6. A list of skills and knowledges necessary was compiled based on the analysis of their activities.

7. The list thus compiled became the basis for recommended development of curricula for baccalaureate degree medical record librarian programs.

Jessie Harold Mickelson,[31] 1956, investigated the knowledges, skills, and personal qualities of medical secretaries. The study sought to determine the secretarial-clerical, and semitechnical tasks performed by outstanding medical secretaries. Medical secretaries included in the study were those considered to be outstanding by local or state executive secretaries of the American Medical Association. Participating physicians were selected on the basis of their understanding of and interest in the training of medical secretaries.

Forty-eight business-office activities were grouped into nine categories and 40 semitechnical medical activities were grouped into five categories and submitted in a questionnaire to the selected secretaries. Responses to the questionnaire items were used to determine how many of the activities were performed in the physician's office, and the classes of personnel who performed each activity.

Five hundred and fifty-seven physicians' employees were sent questionnaires. The response was 428, or 77 per cent.

Personal qualities and the nature of the job were determined by interviews with 32 selected physicians. An interview guide recording form was used to cue the interviewer.

Conclusions drawn from Mickelson's study were:

1. The educational level of medical secretaries should be post-secondary with the four year degree being preferred.

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[31] Jessie Harold Mickelson, "Knowledges, Skills, and Personal Qualities of Medical Secretaries" (unpublished Ph.D. dissertation, School of Education, Indiana University, Bloomington, Indiana, 1956), pp. 1-223.

2. The content of the training should include all generally accepted secretarial skills, business office activities, and all semitechnical medical activities that are ordinarily performed by secretaries or other business office employees.

Meribeth Jeanne Mitchell[32] conducted a study of basic science principles required for associate degree nursing programs to develop an integrated science course. Subject matter included in the recommended integrated science course was determined from responses received to a normative survey check list-type questionnaire that was submitted to junior college nurse educators, graduate nurses, diploma school nursing instructors from cooperating hospitals, curriculum consultants, senior nursing students from three cooperating hospitals, and junior college science instructors.

Nurse educators were asked to respond to the check list in light of what they considered to be desirable science preparation for the student before she enters a particular clinical course.

Curriculum consultants were asked to respond on the basis of whether the subject matter was important for the student nurse in preparation for her clinical work.

Junior college instructors were asked to indicate the amount of emphasis they gave the various principles or facts. They were asked to respond only to area which dealt with the science course they taught.

Senior students were asked to respond on the basis of the emphasis they remembered as being given to a particular principle or fact.

Items included in the check list were selected from a review of current textbooks used in the experimental associate degree nursing programs in chemistry, microbiology, anatomy, and physiology.

On the basis of analysis of the survey data, the principles and facts included in the final course outline were arranged according to the following main headings: nature of matter and energy; the erect and moving body; hemeostasis; nutrition and

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[32]Meribeth Jeanne Mitchell, "Development of an Integrated Science Course for Affiliated Nursing Students in Washington Junior Colleges" (unpublished Ph.D. dissertation, Washington State University, Pullman, Washington, 1959), pp. 1-151.

metabolism; interpretation of and responses to the environment; and reproduction.

T. P. Weil and Henry M. Parrish[33] found in a survey of accreditation standards of 11 allied health fields that a core of basic sciences, sociology, psychology, and management courses may be indicated. They felt that such a program could also serve to indoctrinate students in the inter-disciplinary health-team approach and allow for easy transfer from one field to another.

The first study specifically directly toward the role of the community colleges in preparing technical level workers for the allied health occupations was that reported by Robert E. Kinsinger and Muriel Ratner.[34] Their investigation was concerned with identifying appropriate curricular patterns for health career programs. It was their contention that the key element in the total undertaking of training for the paramedical health occupations within the setting of the community college was the effective utilization of the community's clinical facilities as an "extended campus."

Kinsinger and Ratner utilized 11 curriculum study groups. Ten of the study groups concerned themselves with specific technologies; the eleventh worked at the development of a possible core curriculum. Study groups consisted of professional health practitioners, health service technicians, and community college staff members. The fields studied included: x-ray technician; inhalation therapy technician; dental auxiliary; medical record technician; occupational therapy technician; surgical technician; biomedical engineering technician; opthalmic dispenser; public health technician; medical emergency technician; and foundation "core" curriculum.

Each group produced a report listing an overview of the specific technology and objectives of the particular training program along with a statement of knowledges, understandings, and skills required.

The study group whose responsibility it was to develop a "core" curriculum put together suggestions for a single introductory

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[33]T. P. Weil, "Development of a Coordinated Approach for the Training of Allied Health Personnel," Journal of Medical Education, 42 (July, 1967), 651-659.

[34]Robert E. Kinsinger and Muriel Ratner, Technicians for the Health Field: A Community College Health Careers Study Program (New York: University of the State of New York, 1966), pp. 1-41.

course to the field of health technology. This "Basic Health Technology" course would provide for knowledge of health service resources--interrelationships, functions, activities, plus interpersonal and group dynamics. Also included would be medical team relationships, medical terminology and vocabulary, legal and ethical responsibilities related to the health services, pathophysiology and pathopsychology, diagnostic techniques relating to health care, therapeutic techniques relating to health care, record keeping relating to health services, principles of aspepsis, plus sterilization, disinfection, antiseptis, and selected emergency first-aid procedures.

In addition to the "Basic Health Technology" course, a core of general education courses in anatomy and physiology, psychology or sociology, language arts, mathematics, or other elective courses would be included.

The "core" curriculum study group did recognize two main problems that would be associated with the "core" approach. First of all, some of the on-going health technology programs with differing curriculum patterns governed by state licensure may not fit into the scheme. The "core" concept, though, was considered primarily as a way of helping the uncommitted health technology student. A problem then develops when the uncommitted student selects one of the on-going programs which utilizes knowledges and skills gained in the first term in successive terms. Some way would have to be worked out for such students to make up for their technical deficiencies so they could move into these on-going programs.

In reality, the problem of freedom of movement from a paramedical "core" to on-going programs in specific technologies may well be a transitional one. Much the same problem faced the associate degree nursing programs when they were first under way. Temporary relief was sought and won from restrictive licensure requirements on an experimental basis. Once the programs demonstrated that registered nurses could be successfully trained in the two-year community college setting, license requirements were revised.

A second problem associated with the "core" concept was the resistance that may develop among the students who have already made up their minds to go into specific fields. The study group felt that a two-track system would probably be the course to follow in working out this particular problem.

An investigation conducted under the direction of Bill J. Fullerton, Arthur M. Lee, and Willard M. Fetterhoff[35] undertook

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[35]Bill J. Fullerton, Arthur M. Lee, and Willard M. Fetterhoff, Identification of Common Courses in Paramedical Education (Tempe, Arizona: College of Education, Arizona State University, 1966), pp. 1-153.

to identify the common courses in paramedical education. A workshop consisting of 24 paramedical educators studied curricular materials of 20 paramedical careers from 126 programs in 110 institutions. The contents of 2,613 course titles were examined. These courses were classified and programmed along with level of offering and depth of content, based on clock hours devoted to lecture, laboratory, and clinical experience. Wide variations were found in clock-hour requirement for courses with the same title. Also multiple course titles were found to have the same content. The observation was made that there existed a general absence of standardization.

When reduced to subject matter content, however, there were found to be many commonalities between career programs. The 2,613 courses were reduced to 126 general subject classifications. Of these, 78 subject classifications were found to be common to two or more paramedical programs. High incidence of commonality was found in 12 of the 20 programs. Eight programs had a low commonality incidence. Interestingly enough, there was a higher degree of commonality in programs requiring higher levels of training. Likewise, more standardization occurred in nationally accredited programs, but not as much as would be supposed.

Fullerton et al.,[36] pointed out that many paramedical programs require the same course content. Such courses then could be combined with resultant efficiency in use of faculty, facilities, and materials. To achieve this efficiency, however, precise behavioral course objectives must be established.

Irregularity of general education courses required in paramedical programs caused Fullerton et al., to question the relationship to particular paramedical programs. They felt that much of what is now being taught could possibly be better accomplished in centrally located school systems rather than having each institution operate small classes.

> The results of this research suggest rather strongly that paramedical education today reflects the personal philosophies of educators who have developed a variety of curricula. Additional research would provide a foundation upon which to base new philosophical approaches to paramedical education which are more effective in terms of the tasks to be performed, and which are better able to meet the demands of scientific progress, and changing health manpower requirements.[37]

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[36] Ibid.

[37] Ibid., p. viii.

CHAPTER III

METHODOLOGY

The allied health occupations included in the study were limited to those which currently have training programs being conducted by the community college system of the State of Washington. These occupations included dental assistant, dental technician, occupational therapy assistant, physical therapy assistant, medical assistant, medical records technician, cardio-pulmonary technologist, associate degree registered nurse, licensed practical nurse, x-ray technician, medical secretary, and medical laboratory assistant.

The Population

The population of this study consisted of two groups. The primary group consisted of the allied health occupations professionals who were involved in the pre-employment training programs in the selected allied health occupations. For purposes of this study, the allied health occupations professions included were only those programs where the training period was one academic year or more in length, and that were currently being carried on in community colleges in the State of Washington. As noted in the section under definitions, the term "professional" refers to individuals who have received specialized training in one, or more, of the allied health professions, or occupations, and who because of this training and work experience are qualified to teach in the specific fields. Such individuals were nurses, dental assistants, dental technicians, inhalation thereapists, and so forth. The criteria used in making the final determination was whether they were certified to teach occupational courses in their specific field by the State Coordinating Council for Occupational Education. According to the State Office of Occupational Education, about 250 individuals were certified to teach in pre-employment programs in the allied health occupations in Washington State for the academic year 1967-1968.

The sample taken from this population group was deliberately selective rather than random. Of those surveyed, 32 were nominated to be included in the study by the health occupations program specialist for the Washington State Office of Occupational Education. These individuals were recommended on the basis of their outstanding interest in, and contribution to, program planning and curriculum development in their respective fields. The other

12 individuals included in the category of allied health occupations professionals were faculty members in the Health Occupations Department at Spokane Community College who had demonstrated their concern for curriculum and program planning by their willingness to serve as the panel of experts in the development of the survey instrument.

A total of 50 allied health occupations professionals were asked to respond to the check list. One instructor of medical secretaries was included in the professional list because a four-quarter program was offered by Spokane Community College. An instructor in cardio-pulmonary technology, two occupational therapy assistant program instructors, and one instructor of physical therapy assistants were included even though these programs were only in their first year of a two-year sequence.

The secondary group consisted of 41 practitioners in the allied health occupations who agreed to respond to the questionnaire. In all cases, these practitioners were currently employed in the field for which they were trained. It should be pointed out that it was not possible to include practitioners in cardio-pulmonary technology or physical therapy assistants since no students have yet graduated from these training programs.

The allied health occupation practitioners, except for medical secretaries and associate degree nurses, who were contacted were recommended by the presidents of their respective state, or area, professional associations. These officers were asked to nominate members from their specific fields whom they considered to be particularly interested in improving training programs.

In the case of medical secretaries, who have no officially established professional affiliation, the instructor of the program at Spokane Community College was asked to respond to the questionnaire and also prevailed upon to recommend graduates from her program who should be asked to respond.

Development of Data-Gathering Instrument

To determine the degree to which knowledges are commonly necessary for work in the selected health occupations, a check list-type questionnaire was developed. The questionnaire consisted of 279 knowledges from the fields of anatomy, physiology, microbiology, chemistry, physics, psychology, and sociology. A copy of the questionnaire is included in Appendix A.

Items on the final form of the questionnaire were developed from a preliminary check list of 408 knowledge items which were

selected from reviewing textbooks, reference books, and minimum essentials established by national accrediting, or certifying, associations. To determine if the knowledge items thus selected were appropriate, the preliminary questionnaire was submitted to members of the teaching faculty of the Department of Health Occupations at Spokane Community College. They were asked to respond "yes" or "no" to each item on the basis of whether the knowledge was required of workers in each of their fields. This group of instructors in practical nursing, dental assisting, inhalation therapy, and cardio-pulmonary technology, medical record technicians, and medical secretaries, constituted the panel of experts for the initial questionnaire.

Several members of the panel of experts suggested that the range of choices of response should be widened to permit judgment regarding level of need rather than the single choice of "yes" if a knowledge was considered to be important for their particular area. Accordingly, the final form of the questionnaire provided three choices labeled "essential," "helpful," and "not needed."

Analysis of the tabulated results of the judgments of the panel of experts regarding items included in the preliminary questionnaire resulted in the deletion of 129 items. The final form of the questionnaire included 279 items. The decision to drop an item from the list was based on the evidence that it was considered to be required by only one or two of the health occupation fields.

The 129 knowledges deleted on that basis from the original questionnaire are listed in Appendix B.

Method Used in Distribution of the Data-Gathering Instrument

Questionnaires were mailed to individuals constituting the population. Return self-addressed stamped envelopes were included to encourage returns.

After about 30 days, a follow-up letter was sent to each of the individuals who had not responded. Of the 50 professionals contacted, 48 returned their check lists for a total of 95.7 per cent return.

The greatest difficulty encountered in the study was securing the names of potential respondents in the secondary group consisting of the allied health occupations practitioners.

Table 1 indicates the 12 occupational fields, the number of questionnaires returned (usable and not usable), and the per cent

TABLE 1

OCCUPATIONAL REPRESENTATION OF RESPONDENTS

Job Class	Number Contacted	Usable Returns	Unusable Returns	Per Cent Return
Dental Assistant	39	18	5	56
Dental Laboratory Technician . .	1	1	..	100
Inhalation Therapy and Cardio-pulmonary	25	11	8	76
Medical Assistant	2	2	..	100
Medical Records	10	7	2	90
Associate Degree, Nursing . . .	35	16	6	60
Licensed Practical Nurse	14	14	..	93
Occupational Therapy	8	4	2	88
Physical Therapy	1	1	..	100
X-ray Technician	8	10	..	100
Medical Secretary	3	3	..	100
Medical Laboratory Assistant . .	2	2	..	100
Total	148	89	22	75

of return. Questionnaires considered not usable were returned too late for classification, returned incomplete, or returned by the post office.

The data thus assembled was keypunched onto cards for computer processing. Each completed questionnaire was given a coded six-digit identification number. The first three digits constituted a sequential identification of each individual respondent. The next two numbers, 1 through 12, represented the occupational identity in the same order as they appear in the table above. The last digit was simply a 1 or a 2 for professional educator or occupational practitioner.

A program was written by the data-processing staff at Spokane Community College for the IBM 1620 computer to provide the data.

Data accumulated on each of the 279 knowledge items included:

1. Frequency of no response.
2. Frequency of response "not needed."
3. Frequency of response "helpful."
4. Frequency of response "essential."
5. Per cent of no response.
6. Per cent of response "not needed."
7. Per cent of response "helpful."
8. Per cent of response "essential."
9. Per cent of response "helpful" and "essential."

The data was first run through the computer to produce a composite picture of frequency and percentage of responses to each of the 279 knowledge items.

The information resulting from the first computer run was then sorted to show frequency and percentage of response to each of the knowledge items.

To provide a system for indicating the relative commonality of need for knowledges within each subject matter area, responses were ranked on the basis of the per cent of frequency. This was done for the knowledges checked as "essential" and then for knowledges checked as "helpful" or "essential."

The relative relationship of common usefulness of knowledges between occupations was accomplished by indicating the knowledge items checked "helpful" or "essential" by 60 per cent or more or the respondents in each occupation.

CHAPTER IV

RESULTS AND FINDINGS

The objective of the study was to test the hypothesis that there does exist a commonality of knowledge useful to workers in allied health occupations. Selected knowledges have been clustered into subject matter areas which represent the basic biological, physical, and social science that make up the foundation to the applied sciences of the health professions. This chapter presents the findings regarding the knowledge items required by workers in the selected allied health occupations.

Table 2 shows the percentages of all respondents judging each of the 279 knowledge items to be: "not needed," "helpful," and "essential."

Table 3 shows the percentage rank order of knowledges judged to be "essential" and of knowledges judged to be either "helpful" or "essential."

Table 4 shows the knowledges judged to be "helpful" or "essential" by 60 per cent or more of the respondents in each of the 12 selected allied health occupations.

TABLE 2

PERCENTAGES OF ALL RESPONSES REGARDING THE USEFULNESS OF KNOWLEDGE ITEMS

Number	Knowledge Items	Per Cents of Responses				
		No Response	Not Needed	Helpful	Essential	Helpful & Essential
1	Names and contents of the body cavities	0	5	24	71	95
2	Nature of the animal cell	1	18	52	29	80
3	Nautre and function of protoplasm	1	25	52	22	74
4	Nature and function of cytoplasm	1	25	55	18	74
5	Nature and function of nucleoplasm	1	29	57	13	70
6	Nature and function of nucleus	1	20	56	23	79
7	Nature and function of chromatin	1	31	54	14	68
8	Nature and function of DNA	3	29	57	10	68
9	Nature and function of RNA	5	29	56	10	67
10	Nature of the cell membrane	3	14	46	37	83
11	Difference between mitotic and meotic cell division	2	29	53	16	69
12	Relationship of cells to tissues	1	11	32	55	87
13	Nature and function of connective tissue	0	7	39	54	93
14	Nature and functions of muscle tissue	0	5	29	67	95
15	Chemical basis for muscle fatigue	1	21	47	31	78
16	Nature and function of mucous membrane	0	7	34	59	93
17	Nature and function of nerous tissue	1	7	33	59	92
18	Nature and function of serous membrane	1	13	37	49	86
19	Relationship of tissues to organs	0	8	33	59	92
20	Nature, location, and functions of organs of the digestive system	1	10	29	60	89
21	Processes involved in chemical digestion	1	17	45	37	82
22	Where chemical digestion takes place	1	14	41	44	85

TABLE 2--Continued

23	Nutrient requirements of man	0	16	33	51	84
24	Relationship of enzymes to digestion	0	21	44	36	79
25	Relationship of protein and amino acids	1	23	37	39	76
26	Classification of human foods: protein, vitamins, carbohydrates, and so forth	0	10	41	48	90
27	Sources of body energy and heat	0	9	48	43	91
28	Steps involved in the critic acid cycle of energy release	1	37	55	7	62
29	Relationship of ADP to body energy	1	40	48	10	59
30	Assessory glands of the digestive system and their functions	1	21	25	53	78
31	Where protein digestion occurs	1	23	44	32	76
32	Products of protein digestion	1	30	37	32	69
33	Protein metabolism routes	1	31	39	29	68
34	Where carbohydrate digestion occurs	1	25	36	38	74
35	Products of carbohydrate digestion	1	29	36	34	70
36	Metabolic uses of carbohydrates	1	22	41	36	77
37	Where fat digestion occurs	1	26	34	38	72
38	Products of fat digestion	1	31	33	34	68
39	Metabolic uses of fats	1	26	36	37	72
40	Role of different parts of the digestive tract in absorption	1	26	33	39	72
41	Paths of absorption of fats, proteins, and carbohydrates	1	31	34	33	68
42	Factors which affect metabolic rate	1	16	43	40	83
43	The nature and functions of the skeletal system	1	7	25	67	92
44	Ossification of bone	1	10	43	46	89
45	The functions of bone marrow	1	7	40	52	92
46	Classification of skeletal joints	1	17	24	57	82
47	Significance of muscle tone	1	15	38	46	84
48	Names and functions of the major skeletal muscles	1	14	26	59	85

TABLE 2--Continued

49	Nature and functions of neurons	1	20	43	37	79
50	Functions of the axon	1	29	40	30	70
51	Classification of neurons	1	30	41	28	69
52	The interrelationships between the skeletal, muscular, and nervous system	1	8	33	57	91
53	Nature and function of a reflex arc	1	22	41	36	77
54	Nature of the nerve impulse and how it is transmitted	1	11	44	44	87
55	Nature and function of the perepheral nervous system	1	13	38	48	86
56	Nature and function of the spinal cord	1	10	24	64	89
57	Nature and function of spinal nerve plexuse	1	23	40	36	76
58	Nature and function of spinal nerve plexus terminal branches	1	30	40	29	69
59	Nature and function of autonomic nervous system	1	16	30	53	83
60	Relationship between the sympathetic and parasympathetic nervous system	1	14	36	49	85
61	Role of the nervous system in coordinating body activities	1	15	37	47	84
62	Relationship of sense organs and the nervous system	1	15	31	53	84
63	Nature and function of the eye as a sense organ	1	23	26	49	76
64	Nature and function of the ear as a sense organ	2	24	23	51	74
65	Nature and function of olfactory sense organs	1	23	30	46	76
66	Nature and function of the sense organs of the skin and mucosa	1	10	36	53	89

TABLE 2--Continued

67	Nature and function of the sense organs of muscles and joints	1	21	30	48	78
68	Causes of nervous fatigue	1	18	40	40	80
69	The endocrine glands, their hormone products, and functions	1	13	33	53	86
70	Relationships between hormones and nervous system in coordinating body activities	1	20	43	37	79
71	Relationship between exocrine and endocrine glands	1	15	48	36	84
72	Locations, nature, and functions of the organs of the respiratory system	0	5	17	78	95
73	Mechanics of breathing	0	6	26	68	94
74	Factors controlling respiration rate	0	7	25	68	93
75	Differences between inspired and expired air	0	7	32	61	93
76	Difference between external and internal respiration	1	10	30	59	89
77	Nature, location, and functions of the organs of the circulatory system	1	5	20	75	94
78	Parts and functions of the heart	1	6	20	74	93
79	The anatomy of blood vessels (arteries veins, and capillaries)	0	3	25	71	97
80	Nature and function of pulmonary circulation	1	7	23	69	92
81	Nature and function of coronary circulation	1	6	26	67	93
82	Nature and function of systemic circulation	1	7	28	64	92
83	Causes of heart sounds	1	17	45	37	82
84	How the heart adjusts to change in metabolic activity of body cells	1	20	45	34	79
85	Nature and function of the spleen	1	23	33	43	76
86	Factors involved in maintaining arterial circulation	0	9	32	59	91

TABLE 2--Continued

87	Factors involved in maintaining vencus circulation	0	9	32	59	91
88	The nature and function of blood	1	7	25	67	92
89	How blood protects the body from invading microbes	0	10	37	53	90
90	The nature and functions of lymph	1	10	36	53	89
91	The nature and function of blood clotting	1	8	29	62	91
92	The difference between fetal and infantile blood circulation	1	26	32	40	72
93	How blood contributes to the regulation of body temperature	1	15	36	48	84
94	How blood accomplishes the nutrition of the body	0	17	39	44	83
95	Blood types and their origin	1	24	43	32	75
96	Rh factor as a blood type and its importance	1	25	32	41	74
97	Nature, location, and functions of the organs of the excretory system	1	17	24	57	82
98	Meaning of excretion	1	15	26	57	84
99	Definition of secretion	1	13	26	60	86
100	Factors which contribute to maintaining the acid-base balance	1	24	31	44	75
101	Factors which contribute to increased quantity of urine being produced	1	29	28	43	70
102	Normal physical and chemical characteristics of urine	1	30	30	39	69
103	Excretory organs of the body and their functions	1	21	18	60	78
104	The nature and function of a nephron (physiological unit of the kidney)	1	32	24	43	67

TABLE 2--Continued

105	Relative composition of blood plasma and urine	1	28	39	32	71
106	Abnormal constituents of urine	1	32	32	34	67
107	Structure and function of male and female reproductive organs	1	28	20	52	71
108	Physiological processes associated with female reproduction	1	31	22	46	68
109	Function and development of mammary glands	1	38	21	40	61
110	Normal secretion constituents of mammary glands	1	45	25	29	54
111	Genes and their functions	1	32	34	32	67
112	Fertilization and reproduction	1	36	20	44	63
113	Nature and function of gametes	1	38	37	24	61
114	Significance of microorganisms to human health	0	15	25	60	85
115	Characteristics of bacteria	0	15	34	51	85
116	Characteristics of protozoa	1	20	44	36	79
117	Characteristics of fungi	1	20	38	41	79
118	Characteristics of viruses	1	18	38	43	80
119	Characteristics of actinomycetes	3	30	41	25	67
120	Characteristics of bacteriaophages	3	31	37	29	66
121	Principles of light microscopy	2	48	33	16	49
122	Principles of electron microscopy	2	61	28	9	37
123	How to prepare material for microscope study	1	52	34	13	47
124	Reasons for staining	0	43	39	18	57
125	Types of stains	0	47	34	18	53
126	Micron	5	48	25	22	47
127	Capsule formation	2	52	29	17	46
128	Tissue culture	2	43	39	16	55
129	Pathogen	2	28	28	43	70

TABLE 2--Continued

130	Aseptic technique	0	14	14	72	86
131	Incubation	2	30	31	37	68
132	Cell-fission	2	43	33	22	55
133	Holophytic nutrition	2	64	26	7	33
134	Cultural technique	2	48	29	21	49
135	Pure culture techniques	2	52	26	20	46
136	Autotrophic nutrition	2	64	24	9	33
137	Heterotrophic nutrition	2	66	24	8	32
138	Differential stains	2	51	32	15	47
139	Gram stains	2	41	38	18	56
140	Relationship between environment and microbial growth	2	38	21	39	60
141	Sterilizing	0	8	16	76	92
142	Disinfecting	0	7	17	76	93
143	Antibiotic	0	11	18	70	89
144	Anaerobic	0	17	26	56	83
145	Aerobic	0	18	25	56	82
146	Importance of moisture to bacterial growth	0	22	21	57	78
147	Role of bacteria in organic matter decomposition	1	34	28	37	64
148	Microorganisms and soil fertility	2	59	29	10	39
149	Cultural technique	2	49	32	16	48
150	Matter exists as liquids, solids, or gases	1	21	39	39	78
151	Matter may be found as elements, compounds, or mixtures	1	23	39	37	76
152	Differences between chemical and physical changes in matter	1	22	39	38	77
153	Metric units of measure	2	11	15	71	86
154	Chemical symbols	1	15	43	41	84
155	Conversion of temperature from centigrade to Fahrenheit	1	17	33	48	82

TABLE 2--Continued

156	Most common elements in the body of man	1	16	36	47	83
157	The nature of the chemical reaction combustion	1	36	40	23	63
158	The natural sources of oxygen	1	23	33	43	76
159	How oxygen is prepared for clinical use	1	40	33	25	59
160	The cause of spontaneous combustion and its prevention	1	25	36	38	74
161	Chemical and physical nature of oxygen	1	29	34	36	70
162	Natural occurrence of nitrogen in nature	1	33	47	18	66
163	Relationship between nitrogen : amino acids : urine	1	28	48	23	71
164	Importance of the nitrogen cycle to life	1	33	44	22	66
165	Water as a naturally occurring compound of hydrogen and oxygen	1	24	46	29	75
166	Importance of water to life processes	1	17	32	49	82
167	Importance of water as a constituent of many forms of matter as in water of hydration	2	23	41	33	75
168	Classification of solutions	2	30	39	29	68
169	Importance of solutions to physiological processes	1	28	40	31	71
170	Difference between true solution, colloidal solutions, and suspensions	0	29	39	32	71
171	Differences and similarities between organic and inorganic compounds	1	28	47	24	71
172	Characteristic reactions of acids and bases	1	25	38	36	74
173	Properties of acids and bases	1	25	36	38	74
174	Normal acid and basic salts	1	31	38	30	68
175	How chemical compounds are named	2	45	39	14	53
176	Role of oxygen in living material	1	15	36	48	84

TABLE 2--Continued

177	How oxygen-carbon dioxide balance is maintained in human tissue	2	20	28	51	78
178	How oxygen is used in medicine	1	13	29	57	86
179	Concept of homeostasis	1	17	36	46	82
180	Water reacts with many substances to break down molecules as in hydrolysis digestion	1	31	45	23	68
181	Role of water as a solvent and lubricant	1	24	39	36	75
182	Sources of water for life processes	1	28	33	38	71
183	Role of water in medicine	1	20	37	43	79
184	How heat, light, and time influence chemical reactions	1	26	45	28	72
185	How chemical change affects life processes	1	24	46	29	75
186	Importance of energy as a product of chemical change	1	25	39	34	74
187	Calorie as a measuring unit of energy	1	22	38	39	77
188	Significance of inorganic salts in physiological processes	1	31	44	24	68
189	Uses of common salts in medicine	1	28	44	28	71
190	Differences between acids and bases	1	23	29	47	76
191	Radioactive elements and medicine	1	21	41	37	78
192	Importance of carbon dioxide to life	1	15	33	51	84
193	Unique characteristics of carbon and its role in life processes	1	31	41	26	68
194	Classification of carbon compounds	2	46	38	14	52
195	Significance of carbon compounds in medicine	1	36	48	15	63
196	Sources of fats for human consumption	0	30	32	38	70
197	Sources of carbohydrates for human food	0	26	37	37	74
198	Significance of saturated and unsaturated fats in human nutrition	0	29	38	33	71
199	Role of protein in human nutrition	0	26	31	43	74

TABLE 2--Continued

200	Sources of protein for human food	0	28	34	38	72
201	Relationship between animal and plant protein	0	34	39	26	66
202	Levers in body mechanics	1	26	28	45	72
203	Effects of gravity on man	1	37	26	36	62
204	Nature of gravity	1	39	31	29	60
205	Relationship of gravity and posture	1	32	29	38	67
206	Relationship of vaporization to body heat	2	37	33	28	61
207	Relationship of moisture holding capacity of air and temperature	1	41	33	24	57
208	Relationship of the characteristics of water and the characteristics of protoplasm	1	48	38	13	51
209	Specific gravity	1	48	38	13	51
210	How difference of pressure affects gases and liquids	1	39	31	29	60
211	Friction	1	34	33	31	64
212	Effect of lubricants on friction	2	33	34	30	64
213	Viscosity	2	32	33	32	66
214	Diffusion	1	26	32	40	72
215	Role of diffusion in living tissue	1	30	30	39	69
216	Osmosis	1	20	38	41	79
217	Relationship between isotomic, hypotonic, and hypertonic solutions	1	30	31	38	69
218	Effect of heat on solids and liquids	1	26	41	31	72
219	Effect of short wave radiation on tissue	1	33	34	31	66
220	How x-ray is used in medicine	0	14	33	53	86
221	Effect of radio isotopes on tissue	1	24	36	39	75
222	Medical uses of radio isotopes	1	25	33	40	74
223	Electrical activity of tissue	1	31	45	23	68
224	Static electricity	1	30	39	30	69
225	Factors that affect human behavior	2	6	26	66	92

TABLE 2--Continued

226	Relationship of motivation to learning	3	11	29	56	85
227	Effective study habits	3	9	33	54	87
228	How physical environment affects learning	3	13	33	51	84
229	Physiological factors that affect learning	3	14	29	54	83
230	Laws of learning	3	16	39	41	80
231	Factors involved in conditioning	3	17	43	37	79
232	What is meant by "the learning curve"	3	29	43	25	68
233	Relationship of intelligence to learning	3	18	46	32	78
234	Heredity and learning	3	21	46	30	76
235	Relationship between heredity and environment in human behavior	3	20	33	44	77
236	Mechanisms of human behavior--Stimulus--Modification or Interpretation Response	3	20	39	38	77
237	Stimulus : Receptors	5	20	44	32	76
238	Interpretation : Central Nervous System	3	14	36	47	83
239	Response : Muscles-glands	3	16	36	45	80
240	Relationship of organic needs to human behavior	3	18	34	44	78
241	Relationship of ego needs to human behavior	3	18	31	47	78
242	How physical development and health affect personality	3	9	34	53	87
243	How physical appearance affects personality	3	9	29	59	87
244	How education contributes to personality	3	11	31	54	85
245	Relationship of motivation to personality	3	13	31	53	84
246	Importance of satisfactory adjustment	3	11	34	51	85
247	Frustration	3	8	36	53	89
248	Psychological needs related to growth and development	3	14	30	53	83
249	Relationship between man's biological characteristics and human culture	3	26	36	34	70

TABLE 2--Continued

250	Definition of culture	3	28	33	36	69
251	Relationship of culture to personality	3	23	34	39	74
252	Characteristics of a modern community	3	32	36	29	64
253	Importance of group behavior to the individual	3	17	37	43	79
254	Functions of social groups	3	22	36	39	75
255	Types of social groups	3	22	38	37	75
256	Causes of group conflict	3	21	31	45	76
257	Role of group process in individual adjustment	3	21	29	47	76
258	Types of social institutions	3	23	38	36	74
259	The family as a social institution	3	25	32	39	71
260	Characteristics of American families	3	30	33	33	67
261	Functions of the family	3	26	30	40	70
262	Factors contributing to family disorganization	3	30	32	34	67
263	Factors which contribute to family effectiveness	3	30	32	34	67
264	Effects of family disorganization on the individual	3	28	25	44	69
265	Effects of family disorganization on the rest of the community	3	30	32	34	67
266	Emotional effects of illness	2	8	25	64	90
267	Economic effects of illness	2	14	26	57	84
268	Social effects of illness	2	14	25	59	84
269	Factors contributing to mental illness	2	16	28	54	82
270	Factors contributing to mental deficiency	2	20	29	49	78
271	Changing age distribution and problems of the aged	3	21	29	47	76
272	Social problems of the aged	3	21	29	47	76

TABLE 2--Continued

273	Physical problems of the aged	3	13	29	55	84
274	Mental problems of the aged	2	14	28	56	84
275	Social affects of drug addiction	3	20	31	46	77
276	Individual affects of drug addiction	3	16	26	54	80
277	Social affects of alcoholism	3	20	36	41	77
278	Individual affects of alcoholism	3	15	31	51	82
279	Factors that contribute to poverty	5	25	33	37	70

TABLE 3

PERCENTAGE RANK ORDER OF ITEMS JUDGED "ESSENTIAL" AND OF ITEMS JUDGED EITHER "HELPFUL" OR "ESSENTIAL"

Essential			Helpful or Essential		
No.	Item	Rank	No.	Item	Rank
	Anatomy and Physiology				
72	Locations, nature, and functions of the organs of the respiratory system	1	79	The anatomy of blood vessels (arteries, veins, and capillaries)	1
77	Nature, location, and functions of the organs of the circulatory system	2	72	Locations, nature, and functions of the organs of the respiratory system	3
78	Parts and functions of the heart	3	1	Names and contents of the body cavities	3
79	The anatomy of blood vessels (arteries, veins, and capillaries)	4.5	14	Nature and functions of muscle tissue	3
1	Names and contents of the body cavities	4.5	77	Nature, location, and functions of the organs of the circulatory system	5.5
80	Nature and function of pulmonary circulation	6	73	Mechanics of breathing	5.5
74	Factors controlling respiration rate	7.5	78	Parts and functions of the heart	9.5
73	Mechanics of breathing	7.5	74	Factors controlling respiration rate	9.5
88	The nature and function of blood	10.5	81	Nature and function of coronary circulation	9.5
81	Nature and function of coronary circulation	10.5	75	Differences between inspired and expired air	9.5
43	The nature and functions of the skeletal system	10.5	16	Nature and function of mucous membrane	9.5

TABLE 3--Continued

14	Nature and functions of muscle tissue	10.5
82	Nature and function of systemic circulation	13.5
56	Nature and function of the spinal cord	13.5
91	The nature and function of blood clotting	15
75	Differences between inspired and expired air	16
103	Excretory organs of the body and their functions	18
99	Definition of secretion	18
20	Nature, location, and functions of organs of the digestive system	18
87	Factors involved in maintaining vencus circulation	23
86	Factors involved in maintaining arterial circulation	23
76	Difference between external and internal respiration	23
48	Names and functions of the major skeletal muscles	23
19	Relationship of tissues to organs	23
17	Nature and function of nerous tissue	23
16	Nature and function of mucous membrane	23
13	Nature and function of connective tissue	9.5
80	Nature and function of pulmonary circulation	16
88	The nature and function of blood	16
43	The nature and functions of the skeletal system	16
82	Nature and function of systemic circulation	16
19	Relationship of tissues to organs	16
17	Nature and function of nerous tissue	16
45	The functions of bone marrow .	16
91	The nature and function of blood clotting	22
87	Factors involved in maintaining vencus circulation	22
86	Factors involved in maintaining arterial circulation	22
52	The interrelationships between the skeletal, muscular, and nervous system	22
27	Sources of body energy and heat	22
89	How blood protects the body from invading microbes	25.5
26	Classification of human foods: protein, vitamins, carbohydrates, and so forth	25.5

TABLE 3--Continued

98	Meaning of excretion	28.5
97	Nature, location, and functions of the organs of the excretory system	28.5
52	The interrelationships between the skeletal, muscular, and nervous system	28.5
46	Classification of skeletal joints	28.5
12	Relationship of cells to tissues	31
13	Nature and function of connective tissue	32
90	The nature and functions of lymph	36
89	How blood protects the body from invading microbes . . .	36
69	The endocrine glands, their hormone products, and functions	36
66	Nature and function of the sense organs of muscles and joints	36
62	Relationship of sense organs and the nervous system . . .	36
59	Nature and function of the autonomic nervous system . .	36
30	Assessory glands of the digestive system and their functions	36
107	Structure and function of male and female reproductive organs	40.5
45	The functions of bone marrow .	40.5
56	Nature and function of the spinal cord	29.5
20	Nature, location, and functions of organs of the digestive system	29.5
76	Difference between external and internal respiration	29.5
90	The nature and functions of lymph	29.5
66	Nature and function of the sense organs of muscles and joints	29.5
44	Ossification of bone	29.5
12	Relationship of cells to tissues	33.5
54	Nature of the nerve impulse and how it is transmitted	33.5
99	Definition of secretion	36.5
69	The endocrine glands, their hormone products, and functions	36.5
18	Nature and function of serous membrane	36.5
55	Nature and function of the perepheral nervous system	36.5
48	Names and functions of the major skeletal muscles	40
60	Relationship between the sympathetic and parasympathetic nervous systems	40
22	Where chemical digestion takes place	40

TABLE 3--Continued

64	Nature and function of the ear as a sense organ	42.5
23	Nutrient requirements of man . .	42.5
63	Nature and function of the eye as a sense organ	45
60	Relationship between the sympathetic and parasympathetic nervous systems	45
18	Nature and function of serous membrane	45
93	How blood contributes to the regulation of body temperature	48.5
67	Nature and function of the sense organs of muscles and joints	48.5
55	Nature and function of the peripheral nervous system	48.5
26	Classification of human foods: protein, vitamins, carbohydrates, and so forth	51
61	Role of the nervous system in coordinating body activities .	51
108	Physiological processes associated with female reproduction	53.5
65	Nature and function of olfactory sense organs	53.5
47	Significance of muscle tone . .	53.5
44	Ossification of bone	53.5
112	Fertilization and reproduction .	58
100	Factors which contribute to maintaining the acid-base balance	58
98	Meaning of excretion	45
62	Relationship of the sense organs and the nervous system	45
23	Nutrient requirements of man . .	45
93	How blood contributes to the regulation of body temperature	45
61	Role of the nervous system in coordinating body activities .	45
47	Significance of muscle tone . .	45
71	Relationship between exocrine endocrine glands	45
59	Nature and function of autonomic nervous system	50.5
94	How blood accomplishes the nutrition of the body	50.5
42	Factors which affect metabolic rate	50.5
10	Nature of the cell membrane . .	50.5
97	Nature, location, and functions of the organs of the excretory system	54.5
46	Classification of skeletal joints	54.5
83	Causes of heart sounds	54.5
21	Processes involved in chemical digestion	54.5
68	Causes of nervous fatigue . . .	57.5
2	Nature of the animal cell . . .	57.5
70	Relationships between hormones and nervous system in coordinating body activities	61

TABLE 3--Continued

94	How blood accomplishes the nutrition of the body	58
54	Nature of the nerve impulse and how it is transmitted	58
22	Where chemical digestion takes place	58
104	The nature and function of a nephron (physiological unit of the kidney)	62.5
101	Factors which contribute to increased quantity of urine being produced	62.5
85	Nature and function of the spleen	62.5
27	Sources of body energy and heat	62.5
96	Rh factor as a blood and its importance	65
109	Function and development of mammary glands	67.5
92	The difference between fetal and infantile blood circulation .	67.5
68	Causes of nervous fatigue . . .	67.5
42	Factors which affect metabolic rate	67.5
102	Normal physical and chemical characteristics of urine . . .	71
40	Role of different parts of the digestive tract in absorption	71
25	Relationship of protein and amino acids	73.5
37	Where fat digestion occurs . . .	73.5
49	Nature and functions of neurons	61
24	Relationship of enzymes to digestion	61
84	How the heart adjusts to change in metobolic activity of body cells	61
6	Nature and function of nucleus	61
103	Excretory organs of the body and their functions	65.5
30	Assessory glands of the digestive system and their functions	65.5
67	Nature and function of the sense organs of muscles and joints	65.5
15	Chemical basis for muscle fatigue	65.5
53	Nature and function of a reflex arc	68.5
36	Metabolic uses of carbohydrates	68.5
63	Nature and function of the eye as a sense organ	72.5
65	Nature and function of olfactory sense organs	72.5
85	Nature and function of the spleen	72.5
25	Relationship of protein and amino acids	72.5
57	Nature and function of spinal nerve plexuse	72.5
31	Where protein digestion occurs	72.5

TABLE 3--Continued

34	Where carbohydrate digestion occurs	73.5
83	Causes of heart sounds	77.5
70	Relationships between hormones and nervous system in coordinating body activities	77.5
49	Nature and functions of neurons	77.5
39	Metabolic uses of fats	77.5
21	Processes involved in chemical digestion	77.5
10	Nature of the cell membrane . .	77.5
71	Relationship between exocrine and endocrine glands	83
57	Nature and function of spinal nerve plexuse	83
53	Nature and function of a reflex arc	83
36	Metabolic uses of carbohydrates	83
24	Relationship of enzymes to digestion	83
106	Abnormal constituents of urine .	87.5
84	How the heart adjusts to change in metabolic activity of body cells	87.5
38	Products of fat digestion . . .	87.5
35	Products of carbohydrate digestion	87.5
41	Paths of absorption of fats, proteins, and carbohydrates .	90
111	Genes and their functions . . .	93
105	Relative composition of blood plasma and urine	93
100	Factors which contribute to maintaining the acid-base balance	76.5
95	Blood types and their origin .	76.5
64	Nature and function of the ear as a sense organ	80
96	Rh factor as a blood type and its importance	80
34	Where carbohydrate digestion occurs	80
3	Nature and function of protoplasm	80
4	Nature and function of cytoplasm	80
92	The difference between fetal and infantile blood circulation .	84.5
40	Role of the different parts of the digestive tract in absorption	84.5
37	Where fat digestion occurs . .	84.5
39	Metabolic uses of fats	84.5
107	Structure and function of male and female reproductive organs	87.5
105	Relative composition of blood plasma and urine	87.5
101.	Factors which contribute to increased quantity of urine being produced	90.5
35	Products of carbohydrate digestion	90.5
50	Functions of the axon	90.5
5	Nature and function of nucleoplasm	90.5

TABLE 3--Continued

95	Blood types and their origin . .	93
32	Products of protein digestion .	93
31	Where protein digestion occurs .	93
15	Chemical basis for muscle fatigue	96
50	Functions of the axon	97
110	Normal secretion constituents of mammary glands	99.5
58	Nature and function of spinal nerve plexus terminal branches	99.5
33	Protein metabolism routes . . .	99.5
2	Nature of the animal cell . . .	99.5
51	Classification of neurons . . .	102
113	Nature and function of gametes .	103
6	Nature and function of nucleus .	104
3	Nature and function of protoplasm	105
4	Nature and function of cytoplasm	106
11	Difference between mitotic and meotic cell division	107
7	Nature and function of chromatin	108
5	Nature and function of nucleoplasm	109
29	Relationship of ADP to body energy	111
9	Nature and function of RNA . . .	111
8	Nature and function of DNA . . .	111
28	Steps involved in the critic acid cycle of energy release . . .	113

102	Normal and physical characteristics of urine	95
32	Products of protein digestion .	95
58	Nature and function of spinal nerve plexus terminal branches	95
51	Classification of neurons . . .	95
11	Difference between mitotic and meotic cell division	95
108	Physiological processes associated with female reproduction	100.5
38	Products of fat digestion . . .	100.5
41	Paths of absorption of fats, proteins, and carbohydrates .	100.5
33	Protein metabolism routes . . .	100.5
7	Nature and function of chromatic	100.5
8	Nature and function of DNA	100.5
104	The nature and function of a nephron (physiological unit of the kidney)	105.5
106	Abnormal constituents of urine	105.5
111	Genes and their functions . . .	105.5
9	Nature and function of RNA . .	105.5
112	Fertilization and reproduction	108
28	Steps involved in the critic acid cycle of energy release . . .	109
109	Function and development of mammary glands	110.5
113	Nature and function of gametes	110.5
29	Relationship of ADP to body energy	112
110	Normal secretion constituents of mammary glands	113

TABLE 3--Continued

Microbiology					
142	Disinfecting	1.5	142	Disinfecting	1
141	Sterilizing	1.5	141	Sterilizing	2
130	Aseptic technique	3	143	Antibiotic	3
143	Antibiotic	4	130	Aseptic technique	4
114	Significance of microorganisms to human health	5	114	Significance of microorganisms to human health	5.5
146	Importance of moisture to bacterial growth	6	115	Characteristics of bacteria . .	5.5
145	Aerobic	7.5	144	Anaerobic	7
144	Anaerobic	7.5	145	Aerobic	8
115	Characteristics of bacteria . .	9	118	Characteristics of viruses . . .	9
129	Pathogen	10.5	117	Characteristics of fungi	10.5
118	Characteristics of viruses . . .	10.5	116	Characteristics of protozoa . .	10.5
117	Characteristics of fungi	12	146	Importance of moisture to bacterial growth	12
140	Relationship between environment and microbial growth	13	129	Pathogen	13
147	Role of bacteria in organic matter decomposition	14.5	131	Incubation	14
131	Incubation	16	119	Characteristics of actinomycetes	15
116	Characteristics of protozoa . .	16	120	Characteristics of bacteriaophages	16
120	Characteristics of bacteriaophages	17	147	Role of bacteria in organic matter decomposition	17
119	Characteristics of actinomycetes	18	140	Relationship between environment and microbial growth	18
132	Cell-fission	19.5	124	Reasons for staining	19
126	Micron	19.5	139	Gram stains	20
134	Cultural technique	21	132	Cell-fission	21.5
135	Pure culture techniques	22	128	Tissue culture	21.5
139	Gram stains	24	125	Types of stains	23

TABLE 3--Continued

125	Types of stains	24	134	Pure culture techniques	24.5
124	Reasons for staining	24	121	Principles of light microscopy .	24.5
127	Capsule formation	26	149	Cultural technique	26
149	Cultural technique	27.5	126	Micron	28
128	Tissue culture	27.5	138	Differential stains	28
121	Principles of light microscopy .	29	123	How to prepare material for microscope study	29
138	Differential stains	30	135	Pure culture techniques	30.5
123	How to prepare material for microscope study	31	127	Capsule formation	30.5
148	Microorganisms and soil fertility	32	148	Microorganisms and soil fertility	32
136	Autotrophic nutrition	33.5	122	Principles of electron microscopy	33
122	Principles of electron microscopy	33.5	136	Autotrophic nutrition	34.5
137	Heterotrophic nutrition	35	133	Holophytic nutrition	34.5
133	Holophytic nutrition	36	137	Heterotrophic nutrition	36

Chemistry

153	Metric units of measure	1.5	153	Metric units of measure	1
178	How oxygen is used in medicine .	1.5	178	How oxygen is used in medicine .	2
192	Importance of carbon dioxide to life	4	192	Importance of carbon dioxide to life	3.5
176	Role of oxygen in living material	4	177	How oxygen-carbon dioxide balance	3.5
154	Chemical symbols	4	166	Importance of water to life processes	5
156	Most common elements in the body of man	6	176	Role of oxygen in living material	6.5
166	Importance of water to life processes	8	155	Conversion of temperature from centigrade to Fahrenheit . . .	6.5
155	Conversion of temperature from centigrade to Fahrenheit . . .	8	190	Differences between acids and bases	8.5
179	Concept of homeostasis	8	156	Most common elements in the body of man	8.5
183	Role of water in medicine	10			

TABLE 3--Continued

177	How oxygen-carbon dioxide balance is maintained in human tissue .	12
150	Matter exists as liquids, solids, or gases	12
191	Radioactive elements and medicine	12
187	Calorie as a measuring unit of energy	14.5
152	Differences between chemical and physical changes in matter . .	14.5
190	Differences between acids and bases	17
158	The natural sources of oxygen . .	17
151	Matter may be found as elements compounds, or mixtures	17
181	Role of water as a solvent and lubricant	20.5
167	Importance of water as a constituent of many forms of matter as in water of hydration . . .	20.5
185	How chemical change affects life processes	20.5
165	Water as a naturally occurring compound of hydrogen and oxygen	20.5
199	Role of protein in human nutrition	25.5
173	Properties of acids and bases . .	25.5
160	The cause of spontaneous combustion and its prevention	25.5
197	Sources of carbohydrates for human food	25.5
172	Characteristic reactions of acids and bases	25.5
179	Concept of homeostasis	10
199	Role of protein in human nutrition	12
183	Role of water in medicine	12
158	The natural sources of oxygen . .	12
154	Chemical symbols	14
187	Calorie as a measuring unit of energy	15.5
150	Matter exists as liquids, solids, or gases	15.5
200	Relationship between animal and plant protein	19.5
196	Sources of fats for human consumption	19.5
182	Sources of water for life processes	19.5
173	Properties of acids and bases . .	19.5
160	The cause of spontaneous combustion and its prevention	19.5
152	Differences between chemical and physical changes in matter . .	19.5
197	Sources of carbohydrates for human food	24
191	Radioactive elements and medicine	24
151	Matter may be found as elements, compounds, or mixtures	24
181	Role of water as a solvent and lubricant	27
172	Characteristic reactions of acids and bases	27
161	Chemical and physical nature of oxygen	27

TABLE 3--Continued

186	Importance of energy as a product of chemical change	25.5
200	Sources of protein for human food	29.5
184	How heat, light, and time influence chemical reactions . . .	29.5
182	Sources of water for life processes	34
198	Significance of saturated and unsaturated fats in human nutrition	34
170	Difference between true solution, colloidal solutions, and suspensions	34
169	Importance of solutions to physiological processes	34
189	Uses of common salts in medicine	34
171	Differences and similarities between organic and inorganic compounds	34
163	Relationship between nitrogen: amino acids : urine	34
196	Sources of fats for human consumption	38.5
161	Chemical and physical nature of oxygen	38.5
174	Normal acid and basic salts . .	42
168	Classification of solutions . .	42
193	Unique characteristics of carbon and its role in life processes	40.5
188	Significance of inorganic salts in physiological processes . .	42

186	Importance of energy as a product of chemical change	29
198	Significance of saturated and unsaturated fats in human nutrition	30.5
167	Importance of water as a constituent of many forms of matter as in water of hydration . . .	30.5
170	Difference between true solution, colloidal solutions, and suspensions	32
169	Importance of solutions to physiological processes	33
174	Normal acid and basic salts . .	34
185	How chemical change affects life processes	36
168	Classification of solutions . .	36
165	Water as a naturally occurring compound of hydrogen and oxygen	36
189	Uses of common salts in medicine	38.5
184	How heat, light, and time influence chemical reactions . . .	38.5
201	Relationship between animal and plant	40.5
193	Unique characteristics of carbon and its role in life processes	40.5
159	How oxygen is prepared for clinical use	42
188	Significance of inorganic salts in physiological processes . .	43.5

TABLE 3--Continued

180	Water reacts with many substances to break down molecules as in hydrolysis digestion	42	171	Differences and similarities between organic and inorganic compounds	43.5
201	Relationship between animal and plant protein	46	180	Water reacts with many substances to break down molecules as in hydrolysis digestion	46
164	Importance of the nitrogen cycle to life	46	163	Relationship between nitrogen : amino acids : urine	46
162	Natural occurrence of nitrogen in nature	46	157	The nature of the chemical reaction combustion	46
157	The nature of the chemical reaction combustion	48.5	164	Importance of the nitrogen cycle to life	48
195	Significance of carbon compounds in medicine	48.5	162	Natural occurrence of nitrogen in nature	49
159	How oxygen is prepared for clinical use	50	195	Significance of carbon compounds in medicine	50
175	How chemical compounds are named	51	194	Classification of carbon compounds	51.5
194	Classification of carbon compounds	52	171	Differences and similarities between organic and inorganic compounds	51.5

Physics

220	How x-ray is used in medicine .	1	220	How x-ray is used in medicine .	1
202	Levers in body mechanics	2	216	Osmosis	2
216	Osmosis	3	221	Effect of radio isotopes on tissue	3
222	Medical uses of radio isotopes .	4.5	222	Medical uses of radio isotopes .	4
214	Diffusion	4.5	202	Levers in body mechanics	6
221	Effect of radio isotopes on tissue	6.5	214	Diffusion	6
215	Role of diffusion in living tissue	6.5	218	Effect of heat on solids and liquids	6

TABLE 3--Continued

217	Relationship between isotomic, hypotonic, and hypertonic solutions	8.5
205	Relationship of gravity and posture	8.5
203	Effects of gravity on man	10
209	Specific gravity	11
213	Viscosity	12
219	Effect of short wave radiation on tissue	14
218	Effect of heat on solids and liquids	14
211	Friction	14
224	Static electricity	16.5
212	Effect of lubricants on friction	16.5
210	How difference of pressure affects gases and liquids	18.5
204	Nature of gravity	18.5
206	Relationship of vaporization to body heat	20
207	Relationship of moisture holding capacity of air and temperature	21
223	Electrical activity of tissue . .	22
208	Relationship of the characteristics of water and the characteristics of protoplasm	23

215	Role of diffusion in living tissue	9
217	Relationship between isotomic, hypotonic, and hypertonic solutions	9
224	Static electricity	9
223	Electrical activity of tissue . .	11
205	Relationship of gravity and posture	12
213	Viscosity	13.5
219	Effect of short wave radiation on tissue	13.5
211	Friction	15.5
212	Effect of lubricants on friction	15.5
209	Specific gravity	17
203	Effects of gravity on man	18
206	Relationship of vaporization to body heat	19
210	How difference of pressure affects gases and liquids	20.5
204	Nature of gravity	20.5
207	Relationship of moisture holding capacity of air and temperature	22
208	Relationship of the characteristics of water and the characteristics of protoplasm	23

TABLE 3--Continued

Psychology and Sociology					
225	Factors that affect human behavior	1	225	Factors that affect human behavior	1
266	Emotional effects of illness . . .	2	266	Emotional effects of illness . . .	2
268	Social effects of illness	3.5	247	Frustration	3
243	How physical appearance affects personality	3.5	243	How physical appearance affects personality	5
267	Economic effects of illness . . .	5	227	Effective study habits	5
274	Mental problems of the aged . . .	6.5	242	How physical development and health affect personality . . .	5
226	Relationship of motivation to learning	6.5	226	Relationship of motivation to learning	8
273	Physical problems of the aged . .	8	224	How education contributes to personality	8
276	Individual affects of drug addiction	11	246	Importance of satisfactory adjustment	8
269	Factors contributing to mental illness	11	268	Social effects of illness	11.5
244	How education contributes to personality	11	267	Economic effects of illness . . .	11.5
229	Physiological factors that affect learning	11	274	Mental problems of the aged . . .	11.5
227	Effective study habits	11	273	Physical problems of the aged . .	11.5
248	Psychological needs related to growth and development	15.5	245	Relationship of motivation to personality	11.5
247	Frustration	15.5	228	How physical environment affects learning	11.5
245	Relationship of motivation to personality	15.5	229	Physiological factors that affect learning	17
242	How physical development and health affect personality . . .	15.5	248	Psychological needs related to growth and development	17
278	Individual affects of alcoholism .	19	238	Interpretation : Central Nervous System	17
246	Importance of satisfactory adjustment	19	269	Factors contributing to mental illness	19.5
228	How physical environment affects learning	19	278	Individual affects of alcoholism .	19.5

2

TABLE 3--Continued

270	Factors contributing to mental deficiency	21
272	Social problems of the aged . .	24
271	Changing age distribution and problems of the aged	24
257	Role of group process in individual adjustment	24
241	Relationship of ego needs to human behavior	24
238	Interpretation : Central Nervous System	24
275	Social affects of drug addiction	27
256	Causes of group conflict	28.5
239	Response : Muscles-glands . . .	28.5
264	Effects of family disorganization on the individual	31
240	Relationship of organic needs to human behavior	31
235	Relationship between heredity and environment in human behavior	31
253	Importance of group behavior to the individual	33
277	Social affects of alcoholism . .	34.5
230	Factors involved in conditioning	34.5
261	Functions of the family	36
259	The family as a social institution	38
254	Functions of social groups . . .	38
251	Relationship of culture to personality	38
276	Individual affects of drug addiction	22
239	Response : Muscles-glands . . .	22
230	Laws of learning	22
253	Importance of group behavior to the individual	24.5
231	Factors involved in conditioning	24.5
270	Factors contributing to mental deficiency	27.5
241	Relationship of ego needs to human behavior	27.5
240	Relationship of organic needs to human behavior	27.5
233	Relationship of intelligence to learning	27.5
275	Social affects of drug addiction	31.5
235	Relationship between heredity and environment in human behavior	31.5
277	Social affects of alcoholism . .	31.5
236	Mechanisms of human behavior--Stimulus--Modification or Interpretation Response	31.5
272	Social problems of the aged . .	36.5
271	Changing age distribution and problems of the aged	36.5
257	Role of group process in individual adjustment	36.5
256	Causes of group conflict	36.5
237	Stimulus : Receptors	36.5
234	Heredity and learning	36.5

TABLE 3--Continued

236	Mechanisms of human behavior--Stimulus--Modification or Interpretation Response	38
279	Factors that contribute to poverty	42
255	Types of social groups	42
231	Factors involved in conditioning	42
258	Types of social institutions . .	44.5
250	Definition of culture	44.5
265	Effects of family disorganization on the rest of the community .	47.5
263	Factors which contribute to family effectiveness	47.5
262	Factors contributing to family disorganization	47.5
249	Relationship between man's biological characteristics and human culture	47.5
260	Characteristics of American families	50
237	Stimulus : Receptors	51.5
233	Relationship of intelligence to learning	51.5
234	Heredity and learning	53
252	Characteristics of a modern community	54
232	What is meant by "the learning curve"	55
254	Functions of social groups . . .	40.5
255	Types of social groups	40.5
251	Relationship of culture to personality	42.5
258	Types of social institutions . .	44
259	The family as a social institution	44
261	Factors contributing to family disorganization	46
279	Factors that contribute to poverty	46
249	Relationship between man's biological characteristics and human culture	46
264	Effects of family disorganization on the individual	48.5
250	Definition of culture	48.5
232	What is meant by "the learning curve"	50
265	Effects of family disorganization on the rest of the community .	52.5
263	Factors which contribute to family effectiveness	52.5
262	Factors contributing to family disorganization	52.5
260	Characteristics of American families	52.5
252	Characteristics of a modern community	55

TABLE 4

KNOWLEDGES JUDGED "HELPFUL" OR "ESSENTIAL" BY SIXTY PER CENT OR MORE OF RESPONDENTS IN EACH OCCUPATION

Number	Knowledges	Occupation[a]											
		1	2	3	4	5	6	7	8	9	10	11	12
	Anatomy and Physiology												
1	Names and contents of the body cavities	x	x	x	x	x	x	x	x	x	x	x	x
2	Nature of the animal cell	x		x	x	x	x	x		x	x	x	x
3	Nature and function of protoplasm			x	x		x	x		x	x	x	x
4	Nature and function of cytoplasm			x	x	x	x	x		x	x	x	x
5	Nature and function of nucleoplasm			x	x	x	x	x		x	x	x	x
6	Nature and function of nucleus	x		x	x	x	x	x		x	x	x	x
7	Nature and function of chromatic			x		x	x	x		x	x	x	x
8	Nature and function of DNA			x	x	x	x	x			x	x	x
9	Nature and function of RNA			x	x	x	x	x			x	x	x
10	Nature of the cell membrane	x		x	x	x	x	x		x	x	x	x
11	Difference between mitotic and meotic cell division				x	x	x	x		x	x	x	x
12	Relationship of cells to tissues	x		x	x	x	x	x	x	x	x	x	x
13	Nature and function of connective tissue	x	x	x	x	x	x	x	x	x	x	x	x
14	Nature and functions of muscle tissue	x	x	x	x	x	x	x	x	x	x	x	x
15	Chemical basis for muscle fatigue	x	x	x		x	x	x		x	x	x	x
16	Nature and function of mucous membrane	x	x	x	x	x	x	x	x	x	x	x	x

[a]Dental Assistant--1; Dental Lab. Tech.--2; Inhalation Therapy & C.P.--3; Medical Assistant--4; Medical Records--5; Associate Degree, Nursing--6; Licensed Practical Nurse--7; Occupational Therapy--8; Physical Therapy--9; X-ray Technician--10; Medical Secretary--11; Medical Lab. Assistant--12.

TABLE 4--Continued

17	Nature and function of nerous tissue	x	x	x	x	x	x	x	x	x	x	x	x
18	Nature and function of serous membrane	x	x	x	x	x	x	x	x	x	x	x	x
19	Relationship of tissues to organs	x	x	x	x	x	x	x	x	x	x	x	x
20	Nature, location, and functions of organs of the digestive system	x	x	x	x	x	x	x	x	x	x	x	x
21	Processes involved in chemical digestion	x	x	x		x	x	x	x	x	x	x	x
22	Where chemical digestion takes place	x	x	x	x	x	x	x	x	x	x	x	x
23	Nutrient requirements of man	x			x	x	x	x	x	x	x	x	x
24	Relationship of enzymes to digestion	x			x	x	x	x		x	x	x	x
25	Relationship of protein and amino acids	x			x	x	x	x		x	x	x	x
26	Classification of human foods: protein, vitamins, carbohydrates, and so forth	x			x	x	x	x	x	x	x	x	x
27	Sources of body energy and heat	x		x	x	x	x	x	x	x	x	x	x
28	Steps involved in the critic acid cycle of energy release					x	x	x		x	x	x	x
29	Relationship of ADP to body energy			x		x	x	x		x		x	x
30	Assessory glands of the digestive system and their functions		x		x	x	x	x		x	x	x	x
31	Where protein digestion occurs	x			x	x	x	x		x	x	x	x
32	Products of protein digestion	x				x	x	x		x	x	x	x
33	Protein metabolism routes					x	x	x		x	x	x	x
34	Where carbohydrate digestion occurs	x			x	x	x	x		x	x	x	x
35	Products of carbohydrate digestion	x				x	x	x		x	x	x	x
36	Metabolic uses of carbohydrates	x			x	x	x	x		x	x	x	x
37	Where fat digestion occurs				x	x	x	x		x	x	x	x
38	Products of fat digestion				x	x	x	x		x	x	x	x
39	Metabolic uses of fats	x			x	x	x	x		x	x	x	x
40	Role of different parts of the digestive tract in absorption				x	x	x	x		x	x	x	x
41	Paths of absorption of fats, proteins, and carbohydrates				x	x	x	x		x	x	x	x
42	Factors which affect metabolic rate	x		x	x	x	x	x	x	x	x	x	x

TABLE 4--Continued

43	The nature and functions of the skeletal system	x	x	x	x	x	x	x	x	x	x	x	x
44	Ossification of bone	x	x	x	x	x	x	x	x	x	x	x	x
45	The functions of bone marrow	x	x	x	x	x	x	x	x	x	x	x	x
46	Classification of skeletal joints		x	x	x	x	x	x	x	x	x	x	
47	Significance of muscle tone		x	x	x	x	x	x	x	x	x	x	
48	Names and functions of the major skeletal muscles		x	x	x	x	x	x	x	x	x	x	
49	Nature and functions of neurons			x	x	x	x	x	x	x	x	x	
50	Functions of the axon			x	x	x	x	x	x	x	x	x	
51	Classification of neurons			x	x	x	x	x	x	x	x	x	
52	The interrelationships between the skeletal, muscular, and nervous system	x	x	x	x	x	x	x	x	x	x	x	x
53	Nature and function of a reflex arc			x	x	x	x	x	x	x	x	x	
54	Nature of the nerve impulse and how it is transmitted	x	x	x	x	x	x	x	x	x	x	x	
55	Nature and function of the perepheral nervous system	x	x	x	x	x	x	x	x	x	x	x	
56	Nature and function of the spinal cord		x	x	x	x	x	x	x	x	x	x	
57	Nature and function of spinal nerve plexuse		x	x	x	x	x	x	x	x	x	x	
58	Nature and function of spinal nerve plexus terminal branches		x	x		x	x	x	x	x	x	x	
59	Nature and function of autonomic nervous system		x	x	x	x	x	x	x	x	x	x	
60	Relationship between the sympathetic and parasympathetic nervous system		x	x	x	x	x	x	x	x	x	x	
61	Role of the nervous system in coordinating body activities		x	x	x	x	x	x	x	x	x	x	
62	Relationship of sense organs and the nervous system		x	x	x	x	x	x	x	x	x	x	
63	Nature and function of the eye as a sense organ		x		x	x	x	x	x	x	x	x	

TABLE 4--Continued

64	Nature and function of the ear as a sense organ		x		x	x	x	x	x	x	x	x	
65	Nature and function of olfactory sense organs		x		x	x	x	x	x	x	x	x	
66	Nature andffunction of the sense organs of the skin and mucosa	x	x	x	x	x	x	x	x	x	x	x	
67	Nature and function of the sense organs of muscles and joints		x		x	x	x	x	x	x	x	x	
68	Causes of nervous fatigue	x	x	x	x	x	x	x	x	x	x	x	
69	The endocrine glands, their hormone products, and functions	x		x	x	x	x	x	x	x	x	x	x
70	Relationships between hormones and nervous system in coordinating body activities			x	x	x	x	x	x	x	x	x	x
71	Relationship between exocrine and endocrine glands	x		x	x	x	x	x	x	x	x	x	x
72	Locations, nature, and functions of the organs of the respiratory system	x		x	x	x	x	x	x	x	x	x	x
73	Mechanics of breathing	x		x	x	x	x	x	x	x	x	x	x
74	Factors controlling respiration rate	x		x	x	x	x	x	x	x	x	x	x
75	Differences between inspired and expired air	x		x	x	x	x	x	x	x	x	x	x
76	Difference between external and internal respiration	x		x	x	x	x	x	x	x	x	x	x
77	Nature, location, and functions of the organs of the circulatory system	x	x	x	x	x	x	x	x	x	x	x	x
78	Parts and functions of the heart	x	x	x	x	x	x	x	x	x	x	x	x
79	The anatomy of blood vessels (arteries, veins, and capillaries)	x	x	x	x	x	x	x	x	x	x	x	x
80	Nature and function of pulmonary circulation	x	x	x	x	x	x	x	x	x	x	x	x
81	Nature and function of coronary circulation	x	x	x	x	x	x	x	x	x	x	x	x

TABLE 4--Continued

82	Nature and function of systemic circulation	x	x	x	x	x	x	x	x	x	x	x	x
83	Causes of heart sounds			x	x	x	x	x	x	x	x	x	x
84	How the heart adjusts to change in metabolic activity of body cells			x	x	x	x	x	x	x	x	x	x
85	Nature and function of the spleen			x	x	x	x	x		x	x	x	x
86	Factors involved in maintaining arterial circulation	x		x	x	x	x	x	x	x	x	x	x
87	Factors involved in maintaining vencus circulation	x		x	x	x	x	x	x	x	x	x	x
88	The nature and function of blood	x		x	x	x	x	x	x	x	x	x	x
89	How blood protects the body from invading microbes	x	x	x	x	x	x	x	x	x	x	x	x
90	The nature and functions of lymph	x	x	x	x	x	x	x	x	x	x	x	x
91	The nature and function of blood clotting	x		x	x	x	x	x	x	x	x	x	x
92	The difference between fetal and infantile blood circulation			x		x	x	x		x	x	x	x
93	How blood contributes to the regulation of body temperature	x		x	x	x	x	x		x	x	x	x
94	How blood accomplishes the nutrition of the body	x		x	x	x	x	x		x	x	x	x
95	Blood types and their origins				x	x	x	x		x	x	x	x
96	Rh factor as a blood type and its importance				x	x	x	x	x	x	x	x	x
97	Nature, location, and functions of the organs of the excretory system			x	x	x	x	x	x	x	x	x	x
98	Meaning of excretion			x	x	x	x	x	x	x	x	x	x
99	Definition of secretion	x		x	x	x	x	x	x	x	x	x	x
100	Factors which contribute to maintaining the acid-base balance			x	x	x	x	x		x	x	x	x

TABLE 4--Continued

101	Factors which contribute to increased quantity of urine being produced			x	x	x	x	x		x	x	x	x
102	Normal physical and chemical characteristics of urine			x	x	x	x	x		x	x	x	x
103	Excretory organs of the body and their functions			x	x	x	x	x	x	x	x	x	x
104	The nature and function of a nephron (physiological unit of the kidney)				x	x	x	x		x	x	x	x
105	Relative composition of blood plasma and urine			x	x	x	x	x		x	x	x	x
106	Abnormal constituents of urine				x	x	x	x		x	x	x	x
107	Structure and function of male and female reproductive organs				x	x	x	x	x	x	x	x	
108	Physiological processes associated with female reproduction				x	x	x	x	x	x	x	x	
109	Function and development of mammary glands				x	x	x	x		x	x	x	
110	Normal secretion constituents of mammary glands				x	x	x	x		x		x	
111	Genes and their functions				x	x	x	x		x	x	x	x
112	Fertilization and reproduction				x	x	x	x		x	x	x	
113	Nature and function of gametes				x	x	x	x		x	x	x	x
	Microbiology												
114	Significance of microorganisms to human health	x		x	x	x	x	x	x	x	x	x	x
115	Characteristics of bacteria	x	x	x	x		x	x		x	x	x	x
116	Characteristics of protozoa	x		x	x		x	x		x	x	x	x
117	Characteristics of fungi	x		x	x		x	x		x	x	x	x
118	Characteristics of viruses	x		x	x		x	x		x	x	x	x
119	Characteristics of actinomycetes			x	x		x	x				x	x

TABLE 4--Continued

120	Characteristics of bacteriaophages			x	x		x	x				x	x
121	Principles of light microscopy				x		x					x	x
122	Principles of electron microscopy				x							x	
123	How to prepare material for microscope study				x					x		x	x
124	Reasons for staining	x			x		x	x		x		x	x
125	Types of stains	x			x		x			x		x	x
126	Micron			x	x							x	x
127	Capsule formation				x							x	x
128	Tissue culture	x			x		x					x	
129	Pathogen	x		x	x	x	x	x			x	x	x
130	Aseptic technique	x		x	x		x	x		x	x	x	x
131	Incubation	x		x	x		x	x				x	x
132	Cell-fission	x			x		x	x				x	x
133	Holophytic nutrition				x								
134	Cultural technique	x			x		x						x
135	Pure culture techniques	x			x								x
136	Autotrophic nutrition				x								x
137	Heterotrophic nutrition				x								x
138	Differential stains				x		x					x	x
139	Gram stains	x			x		x					x	x
140	Relationship between environment and microbial growth				x		x	x				x	x
141	Sterilizing	x	x	x	x		x	x		x	x	x	x
142	Disinfecting	x	x	x	x		x	x		x	x	x	x
143	Antibiotic	x		x	x		x	x		x	x	x	x
144	Anaerobic	x		x	x		x	x		x	x	x	x
145	Aerobic	x		x	x		x	x		x	x	x	x
146	Importance of moisture to bacterial growth	x	x	x	x		x	x		x	x	x	x

TABLE 4--Continued

147	Role of bacteria in organic matter decomposition	x			x		x	x		x			x
148	Microorganisms and soil fertility				x								
149	Cultural technique				x		x						x
150	Matter exists as liquids, solids, or gases	x	x	x	x		x	x		x	x	x	x
151	Matter may be found as elements, compounds, or mixtures	x	x	x	x		x	x		x	x	x	x
152	Differences between chemical and physical changes in matter	x	x	x	x		x	x		x	x	x	x
153	Metric units of measure	x	x	x	x		x	x		x	x	x	x
154	Chemical symbols	x	x	x	x		x	x		x	x	x	x
155	Conversion of temperature from centigrade to Fahrenheit	x	x	x	x		x	x		x	x	x	x
156	Most common elements in the body of man	x	x	x	x		x	x		x	x	x	x
157	The nature of the chemical reaction combustion		x	x			x	x		x	x	x	x
158	The natural sources of oxygen	x	x	x	x		x	x		x		x	
159	How oxygen is prepared for clinical use	x	x	x			x	x		x			
160	The cause of spontaneous combustion and its prevention	x	x	x			x	x		x	x		
161	Chemical and physical nature of oxygen	x	x	x	x		x	x		x		x	
162	Natural occurrence of nitrogen in nature	x	x	x			x	x		x		x	
163	Relationship between nitrogen : amino acids : urine			x	x		x	x		x		x	x
164	Importance of the nitrogen cycle to life			x			x	x		x		x	x
165	Water as a naturally occurring compound of hydrogen and oxygen		x	x	x		x	x		x	x	x	x
166	Importance of water to life processes	x	x	x	x		x	x		x	x	x	x

TABLE 4--Continued

167	Importance of water as a constituent of many forms of matter as in water of hydration	x	x	x			x	x		x	x		x
168	Classification of solutions		x	x			x	x		x	x		x
169	Importance of solutions to physiological processes		x	x			x	x		x	x	x	x
170	Difference between true solution, colloidal solutions, and suspensions	x	x	x			x	x		x	x	x	x
171	Differences and similarities between organic and inorganic compounds	x	x	x			x	x		x	x	x	x
172	Characteristic reactions of acids and bases	x	x	x			x	x		x	x		x
173	Properties of acids and bases	x	x	x			x	x		x	x		x
174	Normal acid and basic salts	x	x	x			x	x		x	x		x
175	How chemical compounds are named	x	x	x	x					x			x
176	Role of oxygen in living material	x	x	x	x		x	x		x	x	x	x
177	How oxygen-carbon dioxide balance is maintained in human tissue		x	x	x		x	x		x	x	x	x
178	How oxygen is used in medicine	x	x	x	x		x	x		x	x	x	
179	Concept of homeostasis	x	x	x	x	x	x	x		x	x	x	x
180	Water reacts with many substances to break down molecules as in hydrolysis digestion		x		x		x	x		x	x	x	x
181	Role of water as a solvent and lubricant	x		x			x	x		x	x	x	x
182	Sources of water for life processes	x			x		x	x		x	x	x	x
183	Role of water in medicine	x		x	x		x	x		x	x	x	x
184	How heat, light, and time influence chemical reactions	x	x	x			x	x		x	x	x	x
185	How chemical change affects life processes		x	x	x		x	x		x	x	x	x

TABLE 4--Continued

186	Importance of energy as a product of chemical change		x	x	x		x	x		x	x	x	x
187	Calorie as a measuring unit of energy	x		x	x		x	x		x	x	x	x
188	Significance of inorganic salts in physiological processes		x	x	x		x	x		x	x	x	x
189	Uses of common salts in medicine	x		x	x		x	x		x		x	
190	Differences between acids and bases	x	x	x	x		x	x		x	x	x	x
191	Radioactive elements and medicine	x			x	x	x	x		x	x	x	x
192	Importance of carbon dioxide to life	x		x	x		x	x		x	x	x	x
193	Unique characteristics of carbon and its role in life processes			x			x	x		x		x	x
194	Classification of carbon compounds		x	x				x		x			x
195	Significance of carbon compounds in medicine			x			x	x		x		x	
196	Sources of fats for human consumption	x			x		x	x		x	x	x	x
197	Sources of carbohydrates for human food	x			x		x	x		x	x	x	x
198	Significance of saturated and unsaturated fats in human nutrition	x			x		x	x		x	x	x	x
199	Role of protein in human nutrition	x			x		x	x		x	x	x	x
200	Sources of protein for human food	x			x		x	x		x	x	x	x
201	Relationship between animal and plant protein	x			x		x	x		x		x	
	Physics												
202	Levers in body mechanics		x	x	x		x	x	x	x	x	x	
203	Effects of gravity on man						x	x	x	x	x	x	
204	Nature of gravity		x				x	x	x	x	x	x	
205	Relationship of gravity and posture			x	x		x	x	x	x	x	x	

TABLE 4--Continued

206	Relationship of vaporization to body heat			x	x		x	x		x		x	
207	Relationship of moisture holding capacity of air and temperature			x			x	x		x			
208	Relationship of the characteristics of water and the characteristics of protoplasm						x	x		x		x	
209	Specific gravity		x	x	x		x	x		x	x	x	x
210	How difference of pressure affects gases and liquids		x	x			x	x		x			x
211	Friction		x	x			x	x	x	x	x		
212	Effect of lubricants on friction		x	x			x	x	x	x	x		
213	Viscosity		x	x	x		x	x		x	x	x	
214	Diffusion		x	x	x		x	x		x	x	x	x
215	Role of diffusion in living tissue		x	x	x		x	x		x	x	x	x
216	Osmosis		x	x	x	x	x	x		x	x	x	x
217	Relationship between isotomic, hypotonic, and hypertonic solutions		x	x	x		x	x		x	x	x	x
218	Effect of heat on solids and liquids		x	x	x		x	x		x	x		x
219	Effect of short wave radiatin on tissue	x			x		x	x		x	x	x	
220	How x-ray is used in medicine	x		x	x	x	x	x	x	x	x	x	
221	Effect of radio isotopes on tissue	x			x	x	x	x		x	x	x	x
222	Medical uses of radio isotopes				x	x	x	x		x	x	x	x
223	Electrical activity of tissue		x		x		x	x		x	x	x	
224	Static electricity		x	x	x		x	x		x	x		
	Psychology and Sociology												
225	Factors that affect human behavior	x	x	x	x	x	x	x	x	x	x	x	x
226	Relationship of motivationto learning	x	x	x	x	x	x	x	x	x	x	x	x
227	Effective study habits	x	x	x	x		x	x	x	x	x	x	x
228	How physical environment affects learning	x	x	x	x	x	x	x	x	x	x	x	x

TABLE 4--Continued

229	Physiological factors that affect learning	x	x	x	x	x	x	x	x	x	x	x
230	Laws of learning	x	x	x	x	x	x	x	x	x	x	x
231	Factors involved in conditioning	x	x	x	x		x	x	x	x	x	x
232	What is meant by "the learning curve"		x				x	x	x	x	x	x
233	Relationship of intelligence to learning	x	x			x	x	x	x	x	x	x
234	Heredity and learning	x	x			x	x	x	x	x	x	x
235	Relationship between heredity and environment in human behavior	x	x		x	x	x	x	x	x	x	x
236	Mechanisms of human behavior--Stimulus--Modification or Interpretation Response	x	x	x	x	x	x	x	x	x	x	x
237	Stimulus : Receptors	x	x		x	x	x	x	x	x	x	x
238	Interpretation : Central Nervous System	x	x	x	x	x	x	x	x	x	x	x
239	Response : Muscles-glands	x	x	x		x	x	x	x	x	x	x
240	Relationship of organic needs to human behavior	x	x	x	x	x	x	x	x	x		x
241	Relationship of ego needs to human behavior	x	x	x	x	x	x	x	x	x		x
242	How physical development and health affect personality	x	x	x	x	x	x	x	x	x	x	x
243	How physical appearance affects personality	x	x	x	x	x	x	x	x	x	x	x
244	How education contributes to personality	x	x	x	x	x	x	x	x	x	x	x
245	Relationship of motivation to personality	x	x	x	x	x	x	x	x	x	x	x
246	Importance of satisfactory adjustment	x	x	x	x	x	x	x	x	x	x	x
247	Frustration	x	x	x	x	x	x	x	x	x	x	x
248	Psychological needs related to growth and development	x	x	x	x	x	x	x	x	x	x	x
249	Relationship between man's biological characteristics and human culture	x		x	x	x	x	x	x	x		x
250	Definition of culture	x			x		x	x	x	x		x

TABLE 4--Continued

251	Relationship of culture to pesonality	x			x	x	x	x	x	x	x	x
252	Characteristics of a modern community	x			x			x	x	x	x	x
253	Importance of group behavior to the individual	x			x	x	x	x	x	x	x	x
254	Functions of social groups	x	x		x	x	x	x	x	x	x	x
255	Types of social groups	x	x		x	x	x	x	x	x	x	x
256	Causes of group conflict	x	x		x	x	x	x	x	x	x	x
257	Role of group process in individual adjustment	x			x	x	x	x	x	x	x	x
258	Types of social institutions	x			x		x	x	x	x	x	x
259	The family as a social institution	x			x		x	x	x	x	x	x
260	Characteristics of American families	x			x		x	x	x	x		x
261	Functions of the family	x			x		x	x	x	x		x
262	Factors contributing to family disorganization	x			x		x	x	x	x		x
263	Factors which contribute to family effectiveness	x			x		x	x	x	x		x
264	Effects of family disorganization on the individual	x			x	x	x	x	x	x		x
265	Effects of family disorganization on the rest of the community	x			x	x	x	x	x	x		x
266	Emotional effects of illness	x		x	x	x	x	x	x	x	x	x
267	Economic effects of illness	x		x	x	x	x	x	x	x	x	x
268	Social effects of illness	x		x	x	x	x	x	x	x	x	x
269	Factors contributing to mental illness	x			x	x	x	x	x	x	x	x
270	Factors contributing to mental deficiency	x			x	x	x	x	x	x		x
271	Changing age distribution and problems of the aged	x			x	x	x	x	x	x	x	x
272	Social problems of the aged	x			x		x	x	x	x	x	x
273	Physical problems of the aged	x			x	x	x	x	x	x	x	x
274	Mental problems of the aged	x		x	x	x	x	x	x	x	x	x

TABLE 4--Continued

275	Social affects of drug addiction	x			x		x	x	x		x	x	
276	Individual affects of drug addiction	x			x	x	x	x	x		x	x	
277	Social affects of alcoholism	x			x		x	x	x		x	x	
278	Individual affects of alcoholism	x		x	x	x	x	x	x		x	x	
279	Factors that contribute to poverty	x			x		x	x	x	x		x	
	N = 89 =	18	1	11	2	7	16	14	4	1	10	3	2

CHAPTER V

ANALYSIS, CONCLUSIONS, AND RECOMMENDATIONS

Analysis

The survey instrument was designed to ascertain the usefulness of knowledge items grouped into major subject matter categories: (1) anatomy and physiology, (2) microbiology, (3) chemistry, (4) physics, and (5) psychology and sociology.

The preceding tables show types of knowledges commonly useful for effective work in twelve allied health occupations. Commonality tends to be greatest in occupations most directly related to the practice of medicine as contrasted to occupations associated with dentistry. There is also discernable difference in types of knowledge commonly useful in occupations directly associated with patient care and those useful for laboratory and technician work.

Anatomy and Physiology

Every knowledge item included in the category of anatomy and physiology was judged as helpful or essential by at least 50 per cent or more of 87 respondents representing all 12 occupations. All but seven of the knowledges were marked helpful or essential by more than 65 per cent of the respondents. The category of anatomy and physiology included 113 knowledges which ranged from gross human anatomy and cellular biology to the complex physiological functions of nutrition, circulation, excretion, and reproduction. Only between 20 and 30 per cent of the responses indicated that knowledges specifically related to cellular biology were not needed except for a general understanding of the nature of the animal cell. The same was true for knowledges associated with the processes involved in digestion, sensation, and circulation. Between 30 and 40 per cent of the respondents indicated that knowledge of the complex processes involved in excretion and reproduction were not required. Only two knowledges out of the 113 in the category were marked not needed by between 40 and 50 per cent of the respondents. Thirty-five individuals indicated that a knowledge of the relationship of adenosine diphospate to body energy was not needed. Thirty-nine individuals indicated that workers in their field did not need to know what the normal secretion constituents of the mammary glands were.

The mean of the "helpful" responses to the knowledges in the anatomy and physiology subject matter areas was 30.726. The mean of the "essential" responses to the same knowledges was 38.91. This indicated an almost even division of opinion of those responding as far as the relative emphasis that should be given to the knowledges. Only 16 items in this category were marked essential by 60 per cent or more of those responding. These 16 knowledges were concerned primarily with the circulatory system and external respiration.

From an analysis of the ranking of the knowledge items marked essential in the fields of anatomy and physiology, it was found that the area of primary concern was in the knowledges relating to circulation, respiration, excretion, and gross anatomy. Still in the top half of the rank, but designated as less significant, were those knowledges relating to the nervous system and sensation, reproduction, and integration of body activities.

The occupations of dental assistant, dental technician, and occupational therapy assistant indicated a smaller requirement of knowledges from the subject matter areas of anatomy and physiology.

Sixty per cent or more of all the respondents in each occupation indicated that 20 of the knowledges in this category were either helpful or essential. An additional 20 items were marked either helpful or essential by all but one occupational group. Another 23 knowledges were marked either helpful or essential by 10 of the 12 occupational groups. Except in one case, all of the 113 knowledges in the anatomy and physiology category were marked either helpful or essential by 60 per cent or more of the allied health occupations

Microbiology

Of the 56 knowledges included under the heading of microbiology, 13 or 23.21 per cent received less than a 50 per cent response of either helpful or essential. This is the lowest positive response proportion of all of the knowledge areas. Of the 87 respondents, only between 20 and 30 per cent indicated that nine of the 56 items were not required of workers in the 12 occupations. Between 30 and 40 per cent of the respondents indicated another five items were not needed. Between 40 and 70 per cent of the respondents marked an additional 16 knowledges as not needed.

The knowledges associated with the field of microbiology that received the most favorable response were clearly those most closely related to the clinical aspect ot the science. The areas

which presented a general picture of the relationship of microorganisms to human health, aseptic technique, sterilization, disinfection, and sanitation received either helpful or essential responses from 60 per cent or more of respondents.

The mean of the responses marked helpful in this category was 25.83 with a mean of 28.5 responses essential. Once again, there is an indication of almost even division of opinion as to the relationship of emphasis that should be given to the knowledges within the subject matter area.

The ranking of the knowledges marked essential within the field of microbiology also revealed a tendency to emphasize those items most closely associated with clinical practice. Still included within the top half of the ranking but apparently requiring less emphasis were knowledges related to the general nature of microorganisms and their growth.

The occupations of dental technician, medical record technician, and occupational therapy assistant indicated almost a complete lack of need for knowledge within the field of microbiology. It should be pointed out that there was only one respondent from the occupation of dental technician. It was felt, however, that the reactions of this individual should be taken into account since there are many indications that training programs will be developing in this field in the relatively near future.

Chemistry

As was the case in the subject matter areas of anatomy and physiology, each of the 52 knowledges from the discipline of chemistry were marked either helpful or essential by at least 50 per cent of the respondents. Except for two knowledge items, more than 60 per cent were marked either helpful or essential.

In the case of 29 of the knowledges which dealt with the elementary theoretical aspects of chemistry, between 20 and 30 per cent of the responses were not needed. Much of this effect could be accounted for by the two occupational areas of medical record technician and occupational therapy assistant. As shown in Table 3, all of the items received less than a 60 per cent response as needed (helpful or essential) by the occupational therapy assistants. Only two knowledges were considered to be helpful or essential by at least 60 per cent of the medical record technicians.

Here again, as was the case in the previous two disciplines, there was almost an even division of opinion as far as the relative emphasis that should be given to the knowledge items. The

mean number of responses marked helpful was 23.86 while the mean number of essential responses was 21.556.

The ranking of the items designated as essential from the field of chemistry revealed that there was more concern felt for being familiar with units of measure and symbols than with understanding the theoretical aspects. Also of primary concern was the knowledge relating to the rôle of oxygen, carbon dioxide, and water to life processes.

Two knowledges in this category were singled out for particular emphasis. One was the medical use of oxygen and the other was concerned with the metric system of measure.

Physics

Each of the 23 knowledge items included from the discipline of physics was marked either helpful or essential by 50 per cent or more of the respondents. Again, medical record technicians and occupational therapy assistants indicated little need for the knowledges included in this category. This was also the case with dental assistants, where 60 per cent or more responded either helpful or essential to only the three knowledges dealing with x-ray and radiology. Medical laboratory assistants gave a 60 per cent or more favorable response as helpful or essential to only nine out of the 23 items.

The opinion expressed concerning the relative amount of emphasis was almost exactly neutral. The mean of the number of responses marked ehlpful was 29.217 as compared to a mean of 29.261 for the number of essential responses. There was not any single knowledge or group of knowledges that seemed to need more emphasis than any of the others.

When knowledges in this category marked essential were ranked, it was revealed that the primary emphasis was desired on those knowledges which related most specifically to human and biological activity.

Psychology and Sociology

All 55 of the knowledges derived from the subject matter areas of psychology and sociology were marked either helpful or essential by 60 per cent or more of the 87 respondents. Except for the allied health occupation of medical laboratory assistant, which indicated less than 60 per cent response to all knowledges in this category, there was a high degree of agreement between the other 11 health occupations concerning the knowledges derived

from psychology. Of the 24 knowledges most clearly associated with psychology and personal adjustment, 14 were considered to be either helpful or essential by 60 per cent or more of the responses from 11 of the health occupations. An additional seven out of the 24 were marked either helpful or essential by ten of the occupational groups.

Other than for the occupations of dental technician, inhalation therapy and cardio-pulmonary technology, and medical laboratory assistant, there was a high degree of commonality of required knowledges from the subject matter area of sociology. Ten occupations indicated that seven of the sociological knowledges were required by practitioners. An additional seven knowledges were checked either helpful or essential by 60 per cent or more of the respondents in nine of the occupations.

When ranked by the percentages of responses marked essential from the disciplines of psychology and sociology, the greatest emphasis was given to those aspects that related directly to the patient. Still included in the upper half of the ranking were those knowledges that related more specifically to the psychological development of the individual and his role as a member of society.

Conclusions

The results of this study support the hypothesis that certain cores of knowledge are commonly useful for effective work in twelve allied health occupations included in this study. The greatest degree of common usefulness is among knowledges most directly associated with patient care.

Groups of basic knowledges from the fields of anatomy and physiology were judged to be useful for efficient work by 60 per cent or more of the respondents from all twelve of the occupations. All respondents except medical records technicians and occupational therapy assistants indicated need for knowledge of microbiology. Occupational therapists were the only group to indicate no need for knowledge of chemistry. Respondents from all occupations indicated some need for knowledge of physics. Only the medical laboratory assistants indicated that knowledge of psychology and sociology would not be useful for efficient work.

Because the nature of work performed by medical record technicians is primarily clerical, these workers indicated slight need for chemistry, physics, or microbiology knowledges. Apparently, the primary need of this group of workers was for familiarity with terminology associated with human anatomy and physiology.

The humanistic nature of the work performed by all allied health team workers directly involved with patient contact and functioning in the health-team role involves some use of knowledges from psychology and sociology.

Knowledge clusters identified by this study can reasonably be considered minimums for efficient performance of tasks in which respondents are presently engaged. These facts in no way imply that more knowledge in each of the disciplines would not be an asset to practitioners. A broader base of knowledge would help practitioners to better understand reasons for their work and would provide a foundation for upward occupational mobility.

The study indicates that basic science could be taught by science faculty who are specialized in their respective disciplines--chemistry, biology, physics, psychology, and so forth. Results of the study also suggest that much of such instruction might be usefully organized into a basic interdisciplinary core. Such use of science faculties would free nurses, inhalationists, medical laboratory technicians, and the like, to teach their respective fields of applied science.

Results of this study can be used by those involved in curriculum development as a partial guide to course content for individual training programs, or for -ultiple training programs for workers in the allied health occupations.

Evaluation of present curricula may be enhanced by utilizing the results of this study. It is not intended that these data would suffice as the only evaluative criteria for all allied health occupations curricula. Other sources of information such as recommendations of local advisory committees, minimum essentials established by national organizations, and suggested courses of study from state and national agencies may all contribute to evaluation.

Recommendations

Experiments with ways to teach knowledges demonstrated to be commonly useful to health workers can yield constructive results. Such experiments might include various ways of implementing core curriculum concepts.

Studies of the knowledges associated with performance of specific tasks in the various allied health fields would be useful.

Studies which would provide a scale for indication of the depth of knowledge required for effective work in specific allied health occupations would be useful.

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APPENDIX A

QUESTIONNAIRE

The following general information would be very useful in this study. (All personal or institutional information will be kept confidential.)

In questions 1-4, please fill in the blank with the necessary information.

1. Name_____

2. Present Job Title_____

3. Name of Employing Firm or Institution_____

4. Address of Employing Firm or Institution_____

In questions 5-6 (√) all the answers that apply to you.

5. In which area do you work?

____	1. General Hospital	____	4. Physicians Office
____	2. Psychiatric Hospital	____	5. Nursing Home
____	3. Medical Clinic	____	6. Other, Specify_____

6. Where did you receive your specialized occupational training?

____	1. On the job	____	5. High School
____	2. Military	____	6. Community College
____	3. Trade or technical school	____	7. Senior College or University
____	4. Correspondence	____	8. Other, Specify_____

In questions 7-9, please circle the <u>one</u> answer which applies.

7. Sex: Male Female

8. Age: Under 20 20-30 31-50 Over 50

9. For how many years have you been in your present occupation?
Less than 1 year 1-5 years More than 5 years

Explanation and Instructions

Many institutions offer training leading to employment in health occupations. These occupations are commonly called paramedical, or allied health occupations. Spokane Community College in cooperation with Washington State University has undertaken a study of what must be known by practicing health workers. We want to identify the knowledges used by various types of health occupation workers. We need to find out which knowledges you actually need and use in your particular job. By matching these knowledges with your job, better and more meaningful training programs can be planned.

Will you please fill out the attached questionnaire and return it to us? We assure you that many students and patients will benefit from your assistance.

How to Mark the Questionnaire

If you need and use a knowledge to do your work, place a check (✓) in the column marked "Essential." If the knowledge is helpful as background information check "Helpful."

Example--

Not Needed	Helpful	Essential	
	✓		1. Function of insulin
		✓	2. Symptoms of insulin shock
✓			3. Gametogenisis

COMMON KNOWLEDGES REQUIRED IN HEALTH OCCUPATIONS

Anatomy and Physiology

Not Needed	Help-ful	Essen-tial		
___	___	___	1.	Names and contents of the body cavities.
___	___	___	2.	Nature of the animal cell.
___	___	___	3.	Nature of the animal cell.
___	___	___	4.	Nature and function of cytoplasm.
___	___	___	5.	Nature and function of nucleoplasm.
___	___	___	6.	Nature and function of the nucleus.
___	___	___	7.	Nature and function of chromatin.
___	___	___	8.	Nature and function of DNA
___	___	___	9.	Nature and function of RNA.
___	___	___	10.	Nature of the cell membrane.
___	___	___	11.	Difference between mitotic and meotic cell division.
			12.	Relationship of cells to tissues.
___	___	___	13.	Nature and function of connective tissue.
___	___	___	14.	Nature and functions of muscle tissue.
___	___	___	15.	Chemical basis for muscle fatigue.
___	___	___	16.	Nature and function of mucous membrane.
___	___	___	17.	Nature and function of nervous tissue.
___	___	___	18.	Nature and function of serous membrane.
___	___	___	19.	Relationship of tissues to organs.
___	___	___	20.	Nature, location, and functions of organs of the digestive system.
			21.	Processes involved in chemical digestion.
___	___	___	22.	Where chemical digestion takes place.
___	___	___	23.	Nutrient requirements of man.
___	___	___	24.	Relationship of enzymes to digestion.
___	___	___	25.	Relationship of protein and amino acids.
___	___	___	26.	Classification of human foods: protein, vitamins, carbohydrates, and so forth.
			27.	Sources of body energy and heat.
___	___	___	28.	Steps involved in the citric acid cycle of energy release.
			29.	Relationship of ADP to body energy.
___	___	___	30.	Assessory glands of the digestive system and their functions.
			31.	Where protein digestion occurs.
___	___	___	32.	Products of protein digestion.
___	___	___	33.	Protein metabolism routes.
___	___	___	34.	Where carbohydrate digestion occurs.
___	___	___	35.	Products of carbohydrate digestion.

Not Needed	Help-ful	Essen-tial		
			36.	Metabolic uses of carbohydrates.
			37.	Where fat digestion occurs.
			38.	Products of fat digestion.
			39.	Metabolic uses of fats.
			40.	Role of different parts of the digestive tract in absorption.
			41.	Paths of absorption of fats, proteins, and carbohydrates.
			42.	Factors which affect metabolic rate.
			43.	The nature and functions of the skeletal system.
			44.	Ossification of bone.
			45.	The functions of bone marrow.
			46.	Classification of skeletal joints.
			47.	Significance of muscle tone.
			48.	Names and functions of neurons.
			49.	Nature and functions of neurons.
			50.	Functions of the axon.
			51.	Classification of neurons.
			52.	The interrelationships between the skeletal, muscular, and nervous system.
			53.	Nature and function of a reflex arc.
			54.	Nature of the nerve impulse and how it is transmitted.
			55.	Nautre and function of the perepheral nervous system.
			56.	Nature and function of the spinal cord.
			57.	Nature and function of spinal nerve plexuse.
			58.	Nature and function of spinal nerve plexus terminal branches.
			59.	Nature and function of autonomic nervous system.
			60.	Relationship between the sympathetic and para-sympathetic nervous system.
			61.	Role of the nervous system in coordinating body activities.
			62.	Relationship of sense organs and the nervous system.
			63.	Nature and function of the eye as a sense organ.
			64.	Nature and function of the ear as a sense organ.
			65.	Nature and function of olfactory sense organs.

Not Needed	Help-ful	Essen-tial	
___	___	___	66. Nature and function of the sense organs of the skin and mucosa.
___	___	___	67. Nature and function of the sense organs of muscles and joints.
___	___	___	68. Causes of nervous fatigue.
___	___	___	69. The endocrine glands, their hormone products, and functions.
___	___	___	70. Relationships between hormones and nervous system in coordinating body activities.
___	___	___	71. Relationship between exocrine and endocrine glands.
___	___	___	72. Locations, nature and functions of the organs of the respiratory system.
___	___	___	73. Mechanics of breathing.
___	___	___	74. Factors controlling respiration rate.
___	___	___	75. Differences between inspired and expired air.
___	___	___	76. Difference between external and internal respiration.
___	___	___	77. Nature, location and functions of the organs of the circulatory system.
___	___	___	78. Parts and functions of the heart.
___	___	___	79. The anatomy of blood vessels (arteries, veins, and capillaries).
___	___	___	80. Nature and function of pulmonary circulation.
___	___	___	81. Nature and function of coronary circulation.
___	___	___	82. Nature and function of systemic circulation.
___	___	___	83. Causes of heart sounds.
___	___	___	84. How the heart adjusts to change in metabolic activity of body cells.
___	___	___	85. Nature and function of the spleen.
___	___	___	86. Factors involved in maintaining arterial circulation.
___	___	___	87. Factors involved in maintaining venous circulation.
___	___	___	88. The nature and function of blood.
___	___	___	89. How blood protects the body from invading microbes.
___	___	___	90. The nature and functions of lymph.
___	___	___	91. The nature and function of blood clotting.
___	___	___	92. The difference between fetal and infantile blood circulation.
___	___	___	93. How blood contributes to the regulation of body temperature.
___	___	___	94. How blood accomplishes the nutrition of the body.

Not Needed	Help ful	Essen-tial		
___	___	___	95.	Blood types and their origin.
___	___	___	96.	Rh factor as a blood type and its importance.
___	___	___	97.	Nature, location, and functions of the organs of the excretory system.
___	___	___	98.	Meaning of excretion.
___	___	___	99.	Definition of secretion.
___	___	___	100.	Factors which contribute to maintaining the acid-base balance.
___	___	___	101.	Factors which contribute to increased quantity of urine being produced.
___	___	___	102.	Normal physical and chemical characteristics of urine.
___	___	___	103.	Excretory organs of the body and their functions.
___	___	___	104.	The nature and function of a nephron (physiological unit of the kidney).
___	___	___	105.	Relative composition of blood plasma and urine.
___	___	___	106.	Abnormal constituents of urine.
___	___	___	107.	Structure and function of male and female reproductive organs.
___	___	___	108.	Physiological processes associated with female reproduction.
___	___	___	109.	Function and development of mammary glands.
___	___	___	110.	Normal secretion constituents of mammary glands.
___	___	___	111.	Genes and their functions.
___	___	___	112.	Fertilization and reproduction.
___	___	___	113.	Nature and function of gametes.

Microbiology

___	___	___	114.	Significance of microorganisms to human health.
___	___	___	115.	Characteristics of bacteria.
___	___	___	116.	Characteristics of protozoa.
___	___	___	117.	Characteristics of fungi.
___	___	___	118.	Characteristics of viruses.
___	___	___	119.	Characteristics of actinomycetes.
___	___	___	120.	Characteristics of bacteriaophages.
___	___	___	121.	Principles of light microscopy.
___	___	___	122.	Principles of electron microscopy.
___	___	___	123.	How to prepare material for microscope study.
___	___	___	124.	Reasons for staining.
___	___	___	125.	Types of stains.

Not Needed	Help-ful	Essen-tial		
____	____	____	126.	Micron.
____	____	____	127.	Capsule formation.
____	____	____	128.	Tissue culture.
____	____	____	129.	Pathogen
____	____	____	130.	Aseptic technique.
____	____	____	131.	Incubation.
____	____	____	132.	Cell-fission.
____	____	____	133.	Holophytic nutrition.
____	____	____	134.	Cultural technique.
____	____	____	135.	Pure culture techniques.
____	____	____	136.	Autotrophic nutrition.
____	____	____	137.	Heterotrophic nutrition.
____	____	____	138.	Differential stains.
____	____	____	139.	Gram stains.
____	____	____	140.	Relationship between environment and microbial growth.
____	____	____	141.	Sterilizing.
____	____	____	142.	Disinfecting.
____	____	____	143.	Antibiotic.
____	____	____	144.	Anaerobic.
____	____	____	145.	Aerobic.
____	____	____	146.	Importance of moisture to bacterial growth.
____	____	____	147.	Role of bacteria in organic matter decomposition.
____	____	____	148.	Microorganisms and soil fertility.
____	____	____	149.	Cultural technique.

Chemistry

____	____	____	150.	Matter exists as liquids, solids, or gases.
____	____	____	151.	Matter may be found as elements, compounds, or mixtures.
____	____	____	152.	Difference between chemical and physical changes in matter.
____	____	____	153.	Metric units of measure.
____	____	____	154.	Chemical symbols.
____	____	____	155.	Conversion of temperature from centigrade to Fahrenheit.
____	____	____	156.	Most common elements in the body of man.
____	____	____	157.	The nature of the chemical reaction combustion.
____	____	____	158.	The natural sources of oxygen.
____	____	____	159.	How oxygen is prepared for clinical use.
____	____	____	160.	The cause of spontaneous combustion and its prevention.

Not Needed	Help-ful	Essen-tial		
___	___	___	161.	Chemical and physical nature of oxygen.
___	___	___	162.	Natural occurrence of nitrogen in nature.
___	___	___	163.	Relationship between nitrogen : amino acids : urine.
___	___	___	164.	Importance of the nitrogen cycle to life.
___	___	___	165.	Water as a naturally occurring compound of hydrogen and oxygen.
___	___	___	166.	Importance of water to life processes.
___	___	___	167.	Importance of water as a constituent of many forms of matter as in water of hydration.
___	___	___	168.	Classification of solutions.
___	___	___	169.	Importance of solutions to physiological processes.
___	___	___	170.	Difference between true solutions, colloidal solutions, and suspensions.
___	___	___	171.	Differences and similarities between organic and inorganic compounds.
___	___	___	172.	Characteristic reactions of acids and bases.
___	___	___	173.	Properties of acids and bases.
___	___	___	174.	Normal acid and basic salts.
___	___	___	175.	How chemical compounds are named.
___	___	___	176.	Role of oxygen in living material.
___	___	___	177.	How oxygen-carbon dioxide balance is maintained in human tissue.
___	___	___	178.	How oxygen is used in medicine.
___	___	___	179.	Concept of homeostasis.
___	___	___	180.	Water reacts with many substances to break down molecules as in hydrolysis digestion.
___	___	___	181.	Role of water as a solvent and lubricant.
___	___	___	182.	Sources of water for life processes.
___	___	___	183.	Role of water in medicine.
___	___	___	184.	How heat light and time influences chemical reactions.
___	___	___	185.	How chemical change affects life processes.
___	___	___	186.	Importance of energy as a product of chemical change.
___	___	___	187.	Calorie as a measuring unit of energy.
___	___	___	188.	Significance of inorganic salts in physiological processes.
___	___	___	189.	Uses of common salts in medicine.
___	___	___	190.	Differences between acids and bases.
___	___	___	191.	Radioactive elements and medicine.
___	___	___	192.	Importance of carbon dioxide to life.
___	___	___	193.	Unique characteristics of carbon and its role in life processes.

Not Needed	Help-ful	Essen-tial		
___	___	___	194.	Classification of carbon compounds.
___	___	___	195.	Significance of carbon compounds in medicine.
___	___	___	196.	Sources of fats for human consumption.
___	___	___	197.	Sources of carbohydrates for human food.
___	___	___	198.	Significance of saturated and unsaturated fats in human nutrition.
___	___	___	199.	Role of protein in human nutrition.
___	___	___	200.	Sources of protein for human food.
___	___	___	201.	Relationship between animal and plant protein.

Physics

___	___	___	202.	Levers in body mechanics.
___	___	___	203.	Effects of gravity on man.
___	___	___	204.	Nature of gravity.
___	___	___	205.	Relationship of gravity and posture.
___	___	___	206.	Relationship of vaporization to body heat.
___	___	___	207.	Relationship of moisture holding capacity of air and temperature.
___	___	___	208.	Relationship of the characteristics of water and the characteristics of protoplasm.
___	___	___	209.	Specific gravity.
___	___	___	210.	How difference of pressure affects gases and liquids.
___	___	___	211.	Friction.
___	___	___	212.	Effect of lubricants on friction.
___	___	___	213.	Viscosity.
___	___	___	214.	Diffusion.
___	___	___	215	Role of diffusion in living tissue.
___	___	___	216.	Osmosis.
___	___	___	217.	Relationship between siotonic, hypotonic, and hypertonic solutions.
___	___	___	218.	Effect of short wave radiation on tissue.
___	___	___	219.	Effect of short wave radiation on tissue.
___	___	___	220.	How x-ray is used in medicine.
___	___	___	221.	Effect of radio isotopes on tissues.
___	___	___	222.	Medical uses of radio isotopes.
___	___	___	223.	Electrical activity of tissue.
___	___	___	224.	Static electricity.

Psychology and Sociology

___	___	___	225.	Factors that affect human behavior.

Not Needed	Help-ful	Essen-tial		
___	___	___	226.	Relationship of motivation to learning.
___	___	___	227.	Effective study habits.
___	___	___	228.	How physical environment affects learning.
___	___	___	229.	Physiological factors that affect learning.
___	___	___	230.	Laws of learning.
___	___	___	231.	Factors involved in conditioning.
___	___	___	232.	What is meant by "the learning curve."
___	___	___	233.	Relationship of intelligence to learning.
___	___	___	234.	Heredity and learning.
___	___	___	235.	Relationship between heredity and environment in human behavior.
___	___	___	236.	Mechanisms of human behavior--Stimulus--Modification or Interpretation Response.
___	___	___	237.	Stimulus : Receptors.
___	___	___	238.	Interpretation : Central Nervous System.
___	___	___	239.	Response : Muscles-glands
___	___	___	240.	Relationship of organic needs to human
___	___	___	241.	Relationsip of ego needs to human behavior.
___	___	___	242.	How physical development and health affect personality.
___	___	___	243.	How physical appearance affects personality.
___	___	___	244.	How education contributes to personality.
___	___	___	245.	Relationship of motivation to personality.
___	___	___	246.	Importance of satisfactory adjustment.
___	___	___	247.	Frustration.
___	___	___	248.	Psychological needs related to growth and development.
___	___	___	249.	Relationship between man's biological characteristics and human culture.
___	___	___	250.	Definition of culture.
___	___	___	251.	Relationship of culture to personality.
___	___	___	252.	Characteristics of a modern community.
___	___	___	253.	Importance of group behavior to the individual.
___	___	___	254.	Functions of social groups.
___	___	___	255.	Types of social groups.
___	___	___	256.	Causes of group conflict.
___	___	___	257.	Role of group process in individual adjustment.
___	___	___	258.	Types of social institutions.
___	___	___	259.	The family as a social institution.
___	___	___	260.	Characteristics of American families.
___	___	___	261.	Functions of the family.
___	___	___	262.	Factors contributing to family disorganization.
___	___	___	263.	Factors which contribute to family effectiveness.

Not Needed	Help-ful	Essen-tial		
____	____	____	264.	Effects of family disorganization on the individual.
____	____	____	265.	Effects of family disorganization on the rest of the community.
____	____	____	266.	Emotional effects of illness.
____	____	____	267.	Economic effects of illness.
____	____	____	268.	Social effects of illness.
____	____	____	269.	Factors contributing to mental illness.
____	____	____	270.	Factors contributing to mental deficiency.
____	____	____	271.	Changing age distribution and problems of the aged.
____	____	____	272.	Social problems of the aged.
____	____	____	273.	Physical problems of the aged
____	____	____	274.	Mental problems of the aged.
____	____	____	275.	Social affects of drug addiction.
____	____	____	276.	Individual affects of drug addiction.
____	____	____	277.	Social affects of alcoholism.
____	____	____	278.	Individual affects of alcoholism.
____	____	____	279.	Factors that contribute to poverty.

APPENDIX B

KNOWLEDGE ITEMS DELETED FROM ORIGINAL QUESTIONNAIRE BECAUSE PILOT TESTING INDICATED USEFULNESS IN ONLY ONE OR TWO OCCUPATIONS

Anatomy and Physiology

Names and functions of a-l the skeletal muscles.

Theory of chemical nature of muscle contraction of the body.

Names, functions, origins, innervations of the muscles of the body.

Nature and function of synovial membrane.

Nature and function of cutaneous membrane.

Nature and functions of the organ systems.

Location and function of the glomerulus.

The difference between venous and arterial blood.

Physical and chemical nature of blood.

Factors that influence or control blood pressure.

The nature and functions of the organs of the nervous system

Processes involved in digestion.

Purpose of digestion.

Nature of mechanical digestion.

Embryonic derivation of the digestive tract.

The nerves and blood vessels associated with the digestive tract.

Embryonic origin of the central nervous system.

Anatomy of the brain.

Functions of the various brain regions.

Nature and functions of the twelve pairs of cranial nerves.

Nature and functions of specific ganglia and plexuses of the sympathetic nervous system.

Nature and functions of specific ganglia and plexuses of the parasympathetic nervous system.

Nature and function of the formed particles (cells and platelets) in blood.

Routes of blood flow to any specific part of the body.

Normal blood gas content.

Circulation and innervation of respiratory tract.

Embryonic origin of the organs system.

Definition of enzyme.

Chemistry

Basic concepts of atomic theory.

How and why atoms combine.

The meaning of valence.

Relationship between atomic weight and molecular weight.

Law of definite proportions.

Chemical formulae and equations are shorthand methods of expressing the proportion laws.

Chemical reactions that occur in the body.

Factors that influence the rate of chemical reactions.

How chemicals combine directly.

The difference between simple and double decomposition.

How chemical displacement effects chemical change.

Oxidation-reduction

Role of chemical concentration and catalysts speed up chemical reactions.

The significance of reversable reactions.

Importance of chemical equilibrium in living tissue.

The Kinetic-molecular theory of chemical change.

Classification of chemical compounds according to their characteristics and actions.

The electron theory of oxidation-reduction reactions.

Common oxidizing agents and their uses.

Common reducing agents and their uses.

Physical and chemical properties of hydrogen.

Natural occurrence of hydrogen in nature.

Uses of hydrogen as a reducing agent.

Physical and chemical properties of nitrogen.

Role of nitrogen in living tissues.

The halogens and their role in medicine.

Physiological role of halogens.

How to disinfect and purify water.

How temperature, pressure, concentration, and so forth, affect solubility of substance in water.

Protoplasm as a colloid.

Ionization and electrolytes such as acids, bases and salts.

Importance of ionization in life processes.

Significance of the element carbon to life.

Comparison of organic compounds to inorganic compounds as to number of different forms, stability, solubility, complexity of molecules, combustibility, composition, and activity.

Physical and chemical properties of hydro-carbons and their halogen derivatives.

Chemical and physical nature of carbon compounds containing hydrogen and oxygen such as alcohols, ethers, ketones, and so forth.

Chemical and physical properties of carbon compounds containing hydrogen, oxygen, and nitrogen.

Physical and chemical properties of cyclic carbon compounds.

Role of plants in carbohydrates syntheses. (Photosynthesis)

Role of carbohydrates in human nutrition.

Functions of fats in human nutrition.

Microbiology

Hanging dropslides.

Cocci, streptococci, diplococci.

Flagella, cilia.

Classification of microorganisms.

Characteristics used to classify protosoa.

Characteristics used to classify fungi.

Characteristics used to classify bacteria.

Counterstaining.

Dark-field microscopy.

Physics

Temperature gradient and heat flow.

Temperature change associated with the states of matter.

Relationsip of radiation to body heat.

Relationship of conduction to body heat.

Relationship to convection to body heat.

Surface tension--force that pulls molecules inward.

Relationship between surface tension and "wetting" ability.

Forces affecting capillary attraction: adhesion and cohesion

Factors that affect pressure exerted by gases and liquids.

Pascal's Law. External pressure on confined liquid.

Factors that affect fluid flow.

Boyle's Law.

Charles' Law.

Partial pressure.

Effects of pressure on tissue.

The theoretical advantage of a pulley.

X-ray and gamma rays as short wave radiation.

Electrical conductors and insulators.

Functions of microscope. (How lenses work in microscope function.)

Factors which cause light refraction.

Relationship of vibrations to sound.

Factors that contribute to sound quality and intensity.

Characteristics of protoplasm.

Colloids.

Sol-gel state.

Centripetal force.

Psychology and Sociology

Functions of religious institutions.

Functions of economic institutions.

Functions of governmental institutions.

Ecological processes and social change.

Factors that contribute to population distribution.

Role of invention in social change.

Role of revolution in social change.

Role of accumulation of culture in social change.

Relationship of cultural mores and social problems.

Relationship between rapid and extensive social change to social problems.

Interdependent relationship of all social problems.

Relationship of illness to social problems.

Factors that relieve poverty.

Causes of unemployment.

Individual and social affects of unemployment.

Child welfare and the working mother.

Factors involved in juvenile delinquency.

Factors involved in illegitimacy.

Factors contributing to crime.

Social problems of the transient and homeless.

Role of scientific studies of individual and group needs in the development of social planning.

Race relations and their affect on the community.

Race relations and their affect on the individual.